Matti Raitmaa

Building business roadmaps in a dynamic and disruptive business environment

Helsinki
Metropolia
University of Applied Sciences

Author Title	Matti Raitmaa Building Business Roadmaps in a Dynamic and Disruptive Business Environment
Number of Pages Date	71 pages 8 May 2018
Degree	Master of Engineering
Degree Programme	Business Informatics
Instructor(s)	Thomas Rohweder, Principal Lecturer

This Master's thesis concentrates on identifying relevant business and technology trends and customer requirements on a conceptual level. The methodologies and tools were chosen from existing knowledge related to the categorization of trends and customer requirement that were relevant to the case company and its software product. The synthesis of the existing knowledge and the identified trends and customer requirements indicated the key business and technology drivers that the case company should include in its future business planning and product development.

The conceptual framework of this research concentrated on the methodologies and tools to identify, quantify and prioritize the business and technology trends and customer requirements. Qualitative research methodologies were used in this research and the data collected in three data points were also all qualitative.

The output of this research is a graphical business roadmap, which describes and visualizes the key drivers and trends that should be considered in the business and product development in the next coming years starting immediately once this research is completed. The business roadmap will be used in the development of the case company strategy and the aim is to monitor and update the co-created business roadmap in conjunction with the case company strategy and budget planning in the coming year.

The importance to react and adapt to the changes required related to the identified key business, platform and product technology drivers are essential to case company success in the future. The new technologies are opening new business opportunities and the recommendation is to closely follow up and update the business roadmap to maintain the momentum in being up to date on the latest developments. The research includes actionable information and data so it is further recommended that the stakeholders would take required measures to include the identified elements into the decisions to try and monetize the opportunities the soonest possible and feasible.

Keywords	Business roadmap, business trends, technology trends, forecasting, scenario planning, Telecommunications industry, virtualization, NFV, 5G, IoT, OCS

Helsinki
Metropolia
University of Applied Sciences

Contents

List of Figures

1   Introduction

Albert Einstein has said:

> *I never think of the future. It comes soon enough.*

Albert would most probably not have been that successful in creating business roadmaps if he would have followed his words. (Famous quotes 2018).

The words are well said and have a philosophical meaning, however, the scope of this research is exactly to look into the future and try to systematically analyse business and technology trends, so I will not follow Albert's words. Instead, I will try to look at least 2-3 years into the future, even time flies and future will be present sooner than what we think.

1.1   Business Context

Technologies are developing dynamically and so quickly that it is really challenging to follow up all new technologies that are introduced. Thus, new technology and business trends seem to be introduced before the earlier trend has properly even had time to be implemented in the real world. Still, this is a positive development since new technologies advancement drives the economic growth enabling new ways how we live and how we do business. Therefore, business leaders, researcher included, need to identify new business opportunities in these new technologies in time and consider the impact of the new technologies' to the way how we do business in the future. This all needs to be done and acted upon before any of the new technologies might disrupt our business environment and society. (Manyika 2013).

The amount of various types of communication methods and the amount of data used by people around the world is growing fast. According to Ericsson Mobility Report November 2017, the annual growth rate of mobile data from Q3 2016 to Q3 2017 was 65%. (Ericsson 2018).

Based on the same report, the mobile traffic top three applications between 2017 and 2023 are the video with 48%, social networking with 34% and audio with 32% annual growth rate.

Ericsson is predicting that the compound annual growth rate (CAGR) of 45% results in up to 8 times more mobile data traffic by the end of 2023. (Ericsson 2017).
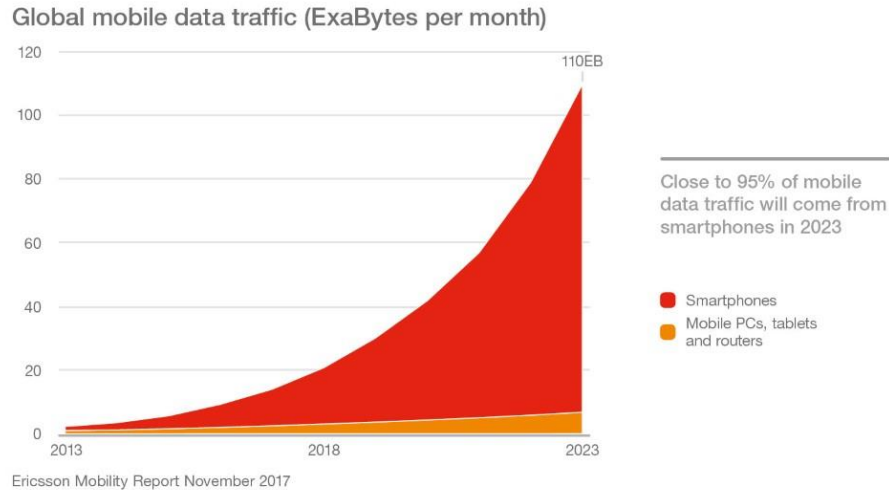
Figure 1. Global mobile data traffic by 2023.

Importance of the growing data traffic for this research is big since the case company software product is used by Telecommunication operators (Telcos) to charge in real time voice call, text messages, and data traffic. The data traffic will grow exponentially in the future and therefore the importance of data traffic charging in regard to the case company is essential and important. The voice and text messages related revenues are decreasing and as an example, one of the case company customer voice related revenues dropped in the last year about 15 % and data revenues grew almost 20%. This trend is expected to continue and some industry expert has said that normal voice calls and text messages will become a commodity service in the future while data is the key revenue generating element at Telcos.

The currently widely used wireless network technology is 4G/LTE technology. The next wireless technology 5G technology is expected to have its first deployments starting from the year 2020 which is only just under 2 years from now. According to the Global System for Mobile Communications (GSMA) the 5G technology allows about 10Gb per second data download speed compared with 100Mb per second with 4G technology. (GSMA 2018). The 5G is not only another improvement of technology as it has been in case of 2G, 3G, and 4G, but it is said to be a major evolution of mobile communication technology enabling a big diversity of capabilities that 4G cannot do such as supporting the full

scale IoT capacity. According to GSMA report 2018, is it estimated that by 2025 globally 53% of the mobile connections are using 4G, 14% are using 5G, 29% are using 3G and 4% are using 2G technologies. (GSMA 2018). This would reflect the total growth of unique mobile subscriptions to grow from 5 billion in 2018 to 5.9 billion in 2025. The 5.9 billion mobile subscriptions exclude the cellular Internet of Things (IoT) subscriptions. (GSMA 2018).

The 5G technology will enable full-scale IoT deployments due to the faster networks. According to GSMA 2018 report, the total IoT connection will grow from 7.5 billion connections in 2017 to 25.1 billion in the year 2025. Thus, Telcos are expected to invest in new 5G network technologies which are highly expensive and challenging from sustainable and profitable business point of view. Based on GSMA estimates, the total cumulative mobile operator estimated CAPEX from 2018 to 2020 is 479 billion US dollars. (GSMA 2018).

In the view to the future 5G network investments, the Telcos are under high pressure to reduce their operative expenditures (OPEX) and capital expenditures (CAPEX). (Sdx central 2018). These are only a few of the business drivers why these operators are looking into enhancing their Networks, Operations Support Systems (OSS) and Business Support Systems (BSS) to support virtualized cloud-based technologies. There is an initiative called Network Function Virtualization (NFV) in which the aim is to separate the above-mentioned solution software functions from the proprietary hardware and use standard hardware for all applications resulting in lower OPEX and CAPEX as well as improved agility and time to market. (Sdx central 2018).

The below picture illustrates the VNFs, the applications such as OCS which are separate from the hardware. (SDx central 2018).
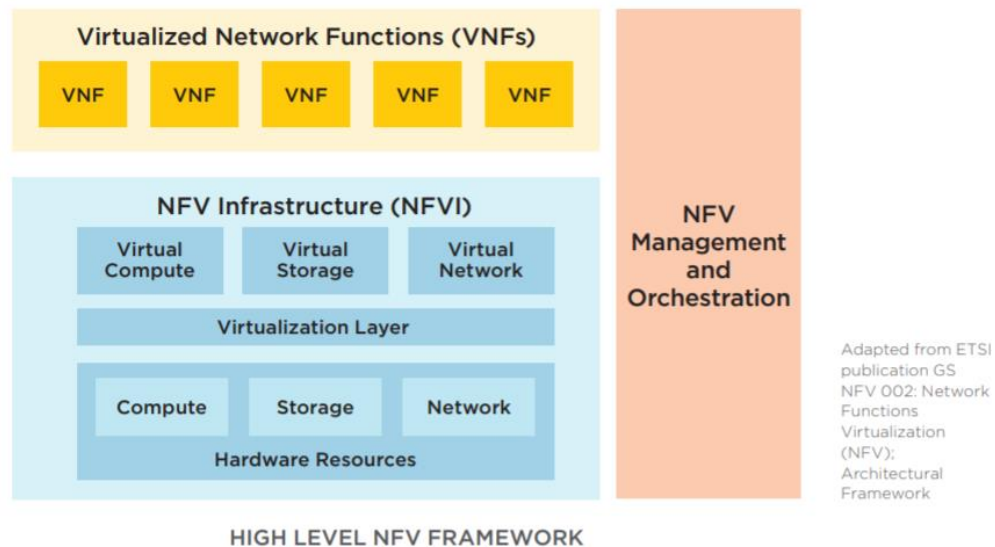
Figure 2. Illustration of NFV framework. (SDx central 2018).

ETSI ISG for NFV is a program driven by ETSI Industry Specification Group (ISG) for Network Functions Virtualization (NFV) jointly with world's leading CSPs. ETSI, European Telecommunications Standards Institute, is a European standard organization defining standards for information and communications technologies within Europe. (SDx central 2018).

This virtualization of the network functions will allow the Telcos to decrease the CAPEX expenditure due to fast testing of new applications and short deployment times as well as annual OPEX due to standard hardware and ability to run several applications on the same hardware.

Telcos see NFV as important for them and according to Telecom TV Survey directed to Telcos globally, 82% of the respondents said NFV for 5G is important or very important for them. (Telecom TV 2017). According to a Network Functions Virtualization Introductory White Paper from 2017, contributed by 23 Telco's globally 'Network Operators believe NFV is a key technology enabler for 5G'. (ETSI 2017). Furthermore, from an application software development point of view, to mention few of them, important matters are the design of a virtualized application is designed according to cloud-native principles and that the licensing models are flexible. There are other critical factors of NFV from a development point of view but these are not a subject of this research in more detail.

In addition to the above-described technology transformation, the Telcos will be required to go through also a business transformation which has a big impact on the operations of these companies. According to Analyses Mason Report in June 2016, the operators will be required to change their operational models and to co-operate with several application vendors simultaneously. This all has an impact on the business requirements that the operators have in the future towards their suppliers. (Analyses Mason 2016).

Moreover, it is essential, that the Telcos will establish step by step development process aiming to a software-defined, data-driven fully automated environment ending as overarching digital business transformation. (Analyses Mason 2016).

The above described NFV implementation path is not that clear yet. While NFV starts to have clearer roadmap, there is no single optimal path for Telcos to choose from. The future implementation paths to choose from are like navigation applications that have alternative routes between fastest, most economic and scenic routes. (Telecom TV 2018).

The case company is a small Finnish software ("SW") developing company that develops a convergent real-time billing and charging application software used by telecommunication operators globally. The case company sells and supports its application SW and related services globally jointly with its global technology partners. The solution has been approved by the case company's customers as the Online Charging Solution ("OCS") network element which is part of their OSS/BSS solutions. In this regard, the case company OCS complies with all requirements and standards that define the industry requirements.

To maintain its competitive advantage in the future and to support the future requirements of the Telcos and CSPs, the case company's solution needs to be developed to support the cloud-based virtualized technologies. This is the key technology which needs to be supported however there are also other technology trends and Telcos future business requirements that need to be clarified and taken into account when planning for the development of the business roadmap of the company.

This research is not going into a product-related detailed feature or standard related requirements but will be focusing on the higher level of business and technology trends.

Also, the case company customer requirements are mostly on the higher level of requirements, related to the product capabilities and the business models.

1.2 Business Challenge

The case company develops, sells and supports an online charging solution (OCS) application software used by telecommunication operators globally. The operators are moving more and more to use cloud-based technologies, potentially in the future including also their OCS solution. The case company's current OCS solution does not support cloud-based technologies thus accordingly a new generation of OCS that meets also dynamically changing customer business requirements needs to be developed in the near future.

The competitors are also developing their solutions to support the cloud technologies so it is important for the case company to do the same, to maintain the competitiveness of the company.

The objective of the research project is to develop a business roadmap for the case company to meet the above-discussed cloud technology challenge in the context of the company's key customer and the business and technology trends related to the charging capabilities of the company's OCS software product.

The outcome of this thesis is to build a business roadmap describing the key business and technology requirements of the key customer and the business and technology trends as well as the business goals in the timeline of 2-3 years forward.

1.3 Key definitions

Here is a list of some key terms definitions that are used in this research.

AMF	*Account Balance Management Function*
CAPEX	*Capital Expenditure*
CTF	*Charging Trigger Function*
CGF	*Charging Gateway Function*
ETSI	*European Telecommunications Standards Institute*
NFV	*Network Function Virtualization*
RF	*Rating Function*

OCF	Online Charging Function
OCS	Online Charging System
OPEX	Operational Expenditure
PLMN	Public Land Mobile Network

1.4 Thesis Outline

The future requirements of various new technologies are difficult to predict precisely and there are a lot of different publications in various media, related to future technologies and trends. Telco's face the same challenge of predicting the development of the trends precisely. Operators typically make their decisions based on their business requirements which are based the real business needs and customer requirements. These are in general the key drivers which the operators would base on their decisions on when building and developing their future networks and other solutions such as the OSS/BSS systems.

The approach of this thesis is to do a qualitative research on the industry-related technology and business journals and identify key trends and drivers that will be important to take into consideration in the building of the case company business roadmap. The thesis focuses on themes and technology areas which are related to the OCS solution and charging of the new future services. Customer interview clarifies the business and technology requirements that they have for their real-time OCS systems and technology vendors in the future.

The thesis starts, in Chapter 1, with an introduction to the business environment where the case company operates and the generic information about the company and its products and services. Chapter 2 describes the project plan and the data collection methods. The project plan includes an illustration of the logical steps of the thesis as well as the inputs and outputs between the steps. Chapter 3 investigates existing knowledge on the methodologies and techniques that are used to categorize business and technology white papers, understanding customer's requirements and creating useful business roadmaps. The output of chapter 3 is the conceptual framework that will be used in the chapters 4 and 5. Chapter 4 identifies the key business and technology drivers and trends related to the OSS business environment and the case customers business requirements. The output of chapter 4 is in a form of a summary of identified change drivers. Chapter 5 includes building the thesis proposal in a form of a business roadmap. Chapter 6 contains the feedback on the proposed roadmap and the final business

roadmap including suggestions in the defined time frame. Chapter 7 will summarize the whole project and evaluation of the thesis.

2   Project plan

This section describes the approach and various steps of this research.

The research design of this project, illustrated in Figure 3 consist of seven steps, five including actionable project steps and the related output of each step. The research include three data collection steps in which first-hand information is collected with the aim of identifying drivers that can potentially lead to expansion of the case company business environment on a framework level. The plan is to build a business roadmap which will take into account the business requirements of our key customer and key industry business and technology trends that could have an impact to the SW product and business development. The findings of the business and technology white papers will give an insight to which key business and technology trends need to be taken into consideration when developing the new generation SW product and possible changes in the business models and processes. In addition, an interview with a key customer of the case company was conducted to gain first-hand information of the business and technology requirements and plans that they have in regard to their OCS systems. The next phase is then to build the business roadmap including the identified technology and business requirements. The roadmap will be thereafter validated and the feedback will be taken into consideration when building the final version of the business roadmap of the case company.

2.1 Research Design

This section describes the overview of the research design in a form of a project plan.
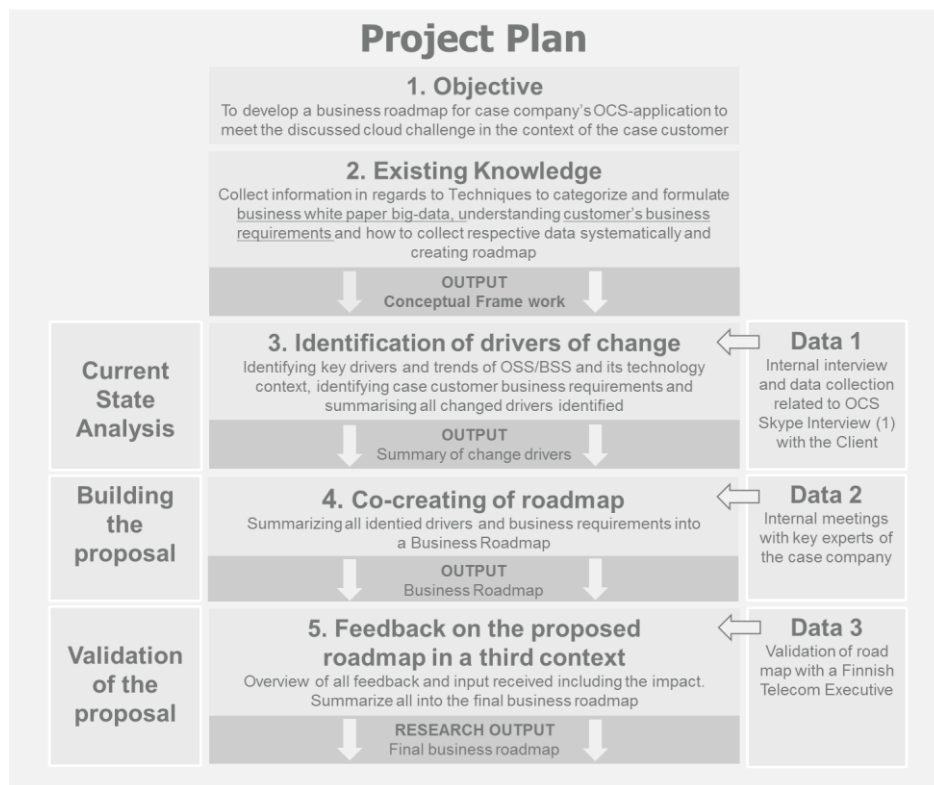
Figure 3. The project plan of the research project

Figure 3 above illustrates the overview of the project plan of the thesis. Number 1 describes the objective of the whole project and what the final output of the thesis is. Number 2 contains 3 conceptual approaches based on which the existing knowledge has been gathered from the literature. The first methodology relates to the categorization and formulation of the trends in business and technology white papers which is the most challenging task. The second tool relates to customer business and technological requirements collection. The third tool is how to create a business roadmap and how to summarize the output from the first and second tools. Number 3 uses the chosen 2 tools to identify key drivers and trends of the OCS solution and its technology context as well as the case customer business and technology requirements. In number 3 there are 3 data inputs illustrated in Figure 3. These key change drivers from number 3 are then summarized and will be used as input to the number 4 in the creation of the roadmap. Once the business roadmap has been completed it will be validated in number 5. In number 5, the road map will be tested in the third context and the feedback impact will be used to finalize the case company's new business roadmap. This will be used as a

suggestion for the case company when developing the case company's strategy for the next 2-3 years. Some items might impact company strategy right after the research has been completed. A useful business roadmap will help the case company to align the activities and plans in a way that generates a sustainable competitive position in the business environment. (Straus et al. 2004).

The same reports suggest that:

> A carefully designed and implemented blend of scenario planning and road mapping can offer "the best of both worlds."

The strategy development of the case company is not within the scope of this research but it is likely that this will take place right after the research has been completed.

2.2 Data Collection and Analysis plan

The objective of the thesis is to build a business roadmap for the case company taking into consideration the future trends and customer requirements, an inductive (bottom-up) approach has been chosen.

The first data stage includes an analysis of selected business and technology white papers based on the methodologies according to the literature review.

Research Data Plan					
Data Round	**Content**	**Data source**	**Informant**	**Schedule**	**Outcome**
Data 1 Current State Analysis	Understanding drivers of change	Insight and trend papers	Internet, business forums, technology forums	Q1 / 2018	Summary of relevant key change drivers
	Identifying customer requirements	Internal interviews and simple email questionnaires	Case company key employee experts	During 2017 and Q1 / 2018	Customer requirements
	Identifying customer requirements	Case customer interview	Case customer senior procurement executive	Case customer phone call interview 7.2.2018	Customer business and technology requirements
Data 2 Building the Proposal	Co - Creating business roadmap based on the outcome of Data 1	Internal Meetings	Case company key employee experts	Q1 / 2018	Business roadmap proposal
Data 3 Validation	Feedback on proposed roadmap	Finnish Telco feedback in writing per email	Finnish Telco senior executive	3.5.2018	Final business roadmap

Figure 4. Research data plan

The selection of the papers is done by the researcher who works for the case company. Furthermore, the researcher has long experience in the telecommunication business environment so the chosen paper collection will be made relatively subjectively. The first data stage also consists of an interview of case company customer which was conducted according to the best practices which have been found from relevant literature. The interviewee is a senior technology procurement professional so his responses are highly valued and can be seen as trustful to be used in the collection of the business and technology requirements of the case customer. Since the case company has a long experience in developing its product based on the customer requirements and telecommunication standards and has employees with extensive experience in the interaction of its customers, the case company experts were included in the process of collecting customer requirements. They were involved according to action research model, in designing the interview protocol and their questions were included in the questions used in the

case customer interview. The results of the responses will be presented to the case company experts once this research is completed. In this way the case company experts will actively take part into development of the case company business. Furthermore, current state analysis of the case company's product was conducted jointly in numerous meetings with the key technical experts of the case company and based on the researcher's own knowledge on the product and customers. The output of the first data stage is a summary of the key change drivers that acts as the input to the case company business roadmap.

The second data stage consists of building a business roadmap following the industry standards and the construction methodologies found from the literature. The built roadmap will act as the summary of the identified key change drivers from the first data stage. The output of the second stage is the actually built proposal in a form of a business roadmap.

The third and final data stage consists of an email communication during which the proposal is validated and the feedback will be used as input to the final proposal. The person who was selected is a senior business executive in a Finnish Telco company belonging to a Nordic Telco Enterprise. This executive has also been the CEO of a Telco abroad belonging to the same Nordic Telco Enterprise. The Telco abroad was using the case company software product so the executive has knowledge of the case company product and of the case company business. This made the selection trustful and feasible for the validation step in this research. In this way, the final proposal will have an outside the case company view to the feasibility of the future looking trends and requirements.

3   Existing knowledge from the literature

This chapter will summarize the techniques and tools that will be used in this research.

3.1   Techniques to categorize and formulate business white papers

The business environment of telecommunication operators is highly dynamic and is changing at an increased pace. There is a huge amount of information related to their business environment and the total volume of new information is increasing more than 30% annually. (Pilkahn 2008). This makes it challenging to pick up the relevant information from the vast amount of business and technology papers and reports that are available in the related business forums on the internet. To find and pick up the right

information at the right time has a big impact on the success of the enterprises. (Pilkahn 2008). Once the enterprise has identified relevant information that can be used to build knowledge it is important to react quickly to gain the maximum strategic advantage of the opportunity. (Pilkahn 2008).

The value and significance of the identified information increases and decreases with time. (Pilkahn 2008).
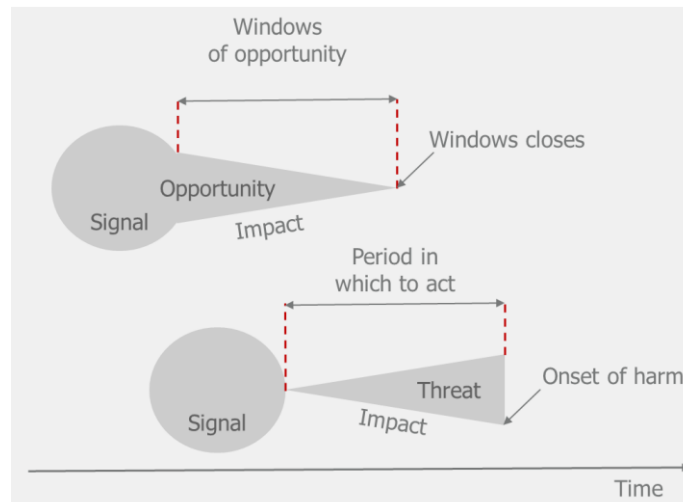
Figure 5. The value of information increases and decreases with time. (Pilkahn 2008).

In the current digital world of internet, it is easy to have access to a big amount of data and information, but the challenge is to be able to convert the information into a strategic knowledge. (Pilkahn 2008). This is one of the reasons which triggered to conduct this research to investigate and learn about the methodologies to do a systematic analysis of information related to future trends and forecasts. To be able to do this it is important to have a systematic approach starting with a definition of the scope of what will be investigated.

The other challenge is to know which of the found relevant information will have the most impact, negative or positive, to the business of the case company. How likely is it and when is it that a certain technological trend is going to be needed and implemented by the industry? This is a continuous question that SW developing companies have. One good way to handle this challenge is to build and maintain an ongoing forecasting process of scanning and monitoring the industry related business and technology trendsetting papers. This gives a good ground for building forecasts which identifies a certain

range of possibilities of the future. How accurate the forecast is, depends on how the actions that we do today will impact the future. The forecast is mapping the uncertainties which are the potential possibilities of the future (Saffo 2007) and the forecast should be supported by a logic. Furthermore, the logic must be possible to be grounded by the forecaster. (Saffo 2007).

The present times that we live in are characterized by rapid changes, dynamic innovation and uncertainty thus the business world is emphasizing more and more to use scenario planning techniques due to their usefulness in times of uncertainty and business environment complexity. The use of scenario planning stimulates strategic thinking which is imperative when building company strategies and managing companies strategically. This, on the other hand, helps to overcome thinking limitations by building multiple possible futures. Furthermore, scenarios are also seen as useful tools when defining alternative futures which are based on various combinations of business and technology trends and related decisions. Scenario planning stimulates managers thinking about multiple futures and considering numerous options. This thinking should reach a point in which the forecasting manager would be encouraged to move outside their comfort zone when evaluating and developing scenarios. In this way, new possibilities will be easier to be found, explored and analysed. (Amer et al. 2012).

The scenario planning process enhances the capability to understand what it takes to make the desired future realistic. It helps to understand what optional futures there might be and if these options are feasible to reach. In the times of increased uncertainty and unpredictability of the business environment that we live in, the importance of identifying the technology and business trends is increasing. Thus, the use of scenario planning has increased and interestingly researchers have indicated a direct link between scenario planning and new technology innovation. (Amer et al. 2012).

The concept of forecasting and scenario planning can be effectively visualized with the cone diagram in Figure 6. The left side of the cone is illustrating the current status of the company and its product and the right side of the cone illustrates the future state of the company and the alternative scenarios and the realm of possibilities which the company could experience in the future. The horizontal axis is showing the progress of time and the increasing diameter of the cone illustrates the increasing uncertainty of the future. In general, the longer the time elapse, the more useful the scenario planning as a tool is.

The arrows inside the cone represent factors that potentially have an impact on the direction that the company or its product could develop towards. The numerous arrow paths demonstrate the several paths and scenario alternatives that there can be. In this research, these paths are illustrating the alternative business and technology trends that would have an impact on the case company and its product future direction, developments, and future state alternatives.

It is important, however to emphasize that the circle to the right suggests a limitation that in reality does not exist because the future in time is unlimited. (Pilkhan 2008 and Amer et al. 2012).
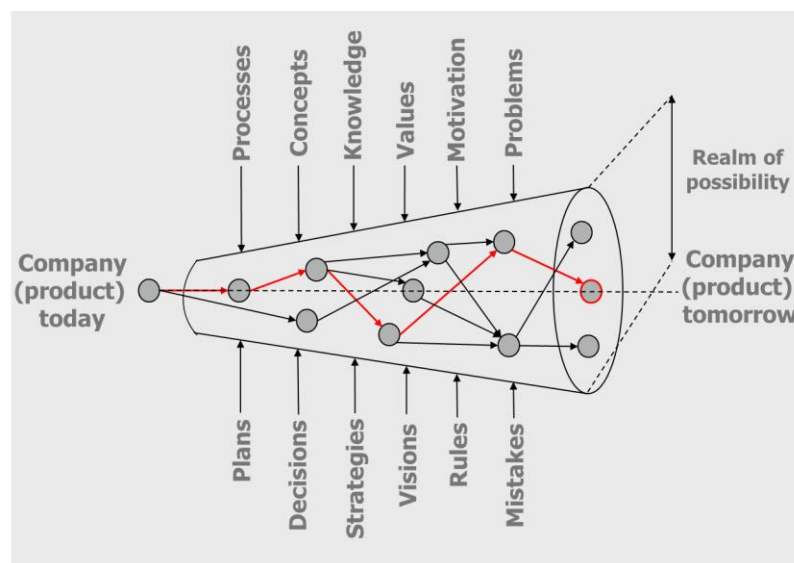
Figure 6. The scenario cone illustrating possible future of the case company and its product.

Ikujiro Nonaka has stated (Pilkahn 2009):

> Knowledge has become the most important raw material of our time: knowledge about technologies, knowledge about markets and consumers, knowledge about the complex relationships among the variables in our environment, and knowledge about relevant future trends.

For enterprises today, it is indispensable to have methods for detecting trends. The trends may suggest opportunities or risks for the companies and it is essential that the companies detect the trends at an early stage to be able to wisely use the new knowledge of the trends when building its strategies for the future. This emphasizes the importance of relevant future trends. So, what are trends? There are several definitions however at

the current time the term "trend" is usually used to describe something that is fashionable or towards which certain things are heading towards. It is commonly used also in the business context of the case company as the direction of a certain technology or business model. Furthermore, in the consumer environment trends can be described as things like types of consumer behaviour. In the context of this research, as an example, the increase of mobile device data consumption can be said to be a mobile user trend. Looking only 10 years back in time, the amount of data consumed by 2G mobile device end users was just a fraction of the data consumption today with the latest models of the 4G smartphones available. It was almost unthinkable how much data a normal consumer could consume with their mobile devices in the future. Based on the same forecasts, the increase of mobile device data consumption trend will continue developing strong. It is estimated that the global amount of mobile data will increase 45% annually ending in 2023 with 110 Exabytes per month. (Ericsson 2017). Thus, a trend can be said to be a change over a period of time. (Pilkahn 2008). At the same time, the Telcos have been suffering from the impact of new applications such as WhatsApp impact to the data consumption and they have struggled to invent methods how they can monetize the related explosion of data increase due to use of these type of new mobile applications.

The aforementioned data consumption trend is a good example of a technology trend that has enabled more mobile data consumption to take place. The technology trend is essentially a new technology that generates new consumer needs which can be seen here as the increased amount of mobile data. (Pilkahn 2008). There are also economic trends that will be evaluated in this research. As an example of an economic trend is a change in business models and value-creation chains. (Pilkahn 2009). This research is conducted bearing in mind microenvironment trends such as market, consumer, product, supplier and competition trends.

To be able to do a systematic analysis of the trends, one needs to classify the trends by strength. One usual method is to classify the strength of trends in terms of dissemination and the potential of the trend to trigger a change, in this case, the potential to change the case company or its product. When a trend is separate or quantifiable, the number of users and the development of users is suggested to qualify as a good metric of trend strength. In case the trend is not quantifiable the strength can only be estimated and is based on observations and information related to the trend. (Pilkahn 2008). In this research, part of the trend strength estimation is based on general grounded observation and subjective experience of the researcher. This approach is supported by the fact that

since the trend direction and strength are impacted by the drivers and forces, the case company can influence the trends. (Pilkahn 2008).

Simultaneously, when conducting an analysis of trends, it is important to remember that the various study reports and trendsetting whitepapers are not facts and that they include always a degree of suppositions and speculations. Moreover, one needs to be careful on how appropriate and reliable a trend analysis is, sometimes aiming at maximum media impact, to be used when developing strategies and building business roadmaps in a corporate environment. (Pilkahn 2008). Based on the experience of reading trendsetting business white papers, in this case, related to the telecommunications industry during the last 2 years, it seems that the direction of the trends is changing depending on the success of implementing the new technologies at the Telcos. This aspect is also taken into account when analysing the trends in this research.

In addition to the number of users and development of users, business value and potential, as well as the scope of impact, are suggested to be useful metrics for the trend strength. (Manyika et al. 2013). Furthermore, since the drivers can be influenced by the case company, the case company can have an effect to the strength of the trend (Pilkahn 2008) and therefore it is grounded that the case company can also grade subjectively the trends in table 1 below.

Based on the aforementioned metrics of strengths, a table below can be used to describe the potential and strength of a specific chosen technology or business trend as well as the customer requirements.

Trend #	Business potential and value	Number of users	Case company grading (1-3)
T1			
T2			
T3			
…			
Tn			

Table 1. Business potential and value, number of users and case company subjective grading of the trend

The above tool will be utilized to list, describe and quantify the chosen trends in a systematic method. The listed and ranked trends will then be evaluated and prioritized further in the next steps. There are trends that can be seen as high impact trends in general but might not be seen as that important or feasible for the case company.

The aim for this research is to use the selected tools to identify and select the most lucrative and feasible trends that the case company could potentially monetize in its telecommunication business environment related software product, services or business models. Effective and useful tools for this purpose according to researchers are issues-priorities matrix and cross-impact analysis tools. These are useful tools when analysing and evaluating the probability of selected trends and technology and business drivers. In this research, the issues-priorities matrix is more feasible due to the scope limitation of the research. Therefore, it is selected as the scenario planning and prioritization tool.

3.2   Understanding customers business requirements and how to collect respective data systematically

As said in earlier chapters, technologies are moving dynamically and so quickly that it is really challenging to follow up all the new technologies that are introduced. Furthermore, the customers have their own specific requirements which sometimes are challenging and time-consuming to fulfil and implement. The customer's budgets are tight and expectation is to have high quality with low expenditure. This said, the importance of requirements gathering, including data and process, is vital in application development. (Smith 2000).

To maintain the competitiveness high in the demanding IT industry, software vendors must fulfil all requirements with short requirement-to-revenue time, particularly because otherwise there is a high risk that customers will find another vendor to fulfil their requirements.

Understanding customers' needs and requirements help enterprises to build positive and good relationships with their customers. Furthermore, understanding the customer helps the enterprises to develop their products and services to fit the customer needs and enable to personalize the services to increase the customer experience.

It is not difficult to collect information from customers but it is difficult to collect information which is of use when developing and planning new product capabilities, services, and strategies for the company. (Ulwick 2003). Moreover, it is challenging to collect customer information that could transform an innovation into an efficient and feasible business process. (Ulwick 2003). Subsequently, the useful information helps customers to get the "job" done when using the product or service, to achieve the outcomes when executing

the jobs and to delete the constraints that stops them using the product or service. Understanding the jobs and the outcomes that the customers are aiming at, and the constraints and obstacles they are trying to overcome, will improve possibilities to succeed in business because then one knows where and how to create value to the customer. (Ulwick 2003).

Accordingly, in the customer-driven approach, the enterprises base the product and services development on the customer requirements. One approach is to listen carefully what the customer says and use this type of information in the enterprise innovation process. This approach is called the "voice-of-the-customer" and as an example, the types of voices are complaints from the customers, product returns, contract cancellations and market share changes. The sources of customer information are illustrated in Figure 7 below.
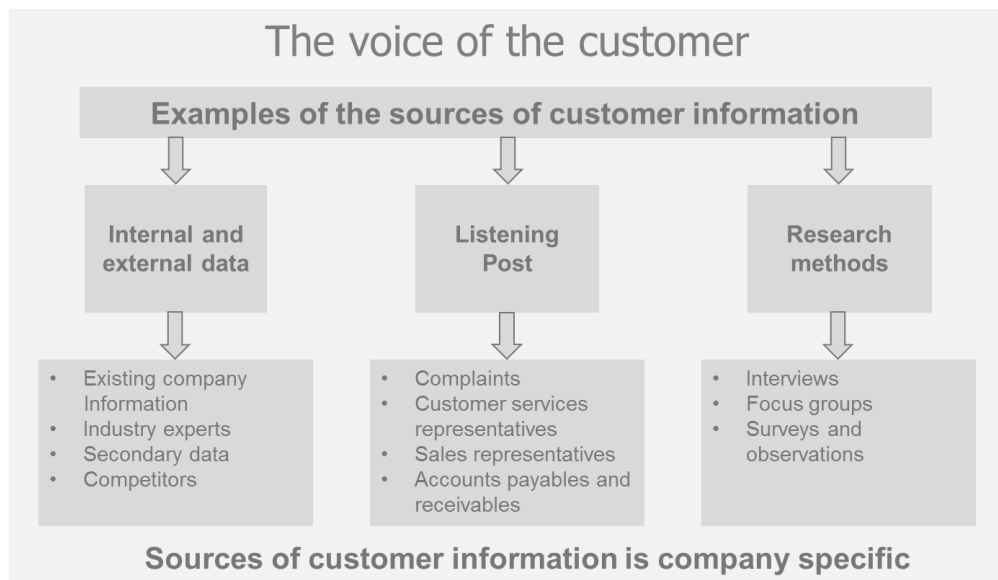
Figure 7. The voice of the customer illustration

In regard to the case company, the customer support team is one of the key entry points of information from the case company customers.

There is a big amount of different methods of collecting business and technology requirements from customers. The techniques are different and the suitability of a technique depends on the project and the company conducting its requirements collection. Therefore, the usefulness of a specific technique depends on the requirements and advantages that the tool provides to the project. (Dehra 2011).

Based on the numerous researchers and business analysts, to mention just a few, the most used techniques are interviews, surveys, questionnaires, requirements workshops, idea mapping and request for proposals. (Mack 2011, Edwards et al. 2013, Nagar 2015, Mochal 2008, Master of Project Academy 2018).

Surveys and questionnaires are mainly used for large groups which takes a long time and typically several researchers. The idea of the workshop is to collect and gather requirements jointly with the customer including presentation of the product roadmap and interactive idea mapping. This method is commonly used at the case company and the typical participants are the technical operations and support team member at the customer side. Request for proposals from the customers act as a good process to compare the capabilities of the own product and services against the customers' requirements and needs.

Market research is a larger separate research compounding of several tools mentioned above including large market evaluations and analysis however in the scope of this research, market research is not a feasible method of collecting information from the case company customer.

This research is a qualitative research and to gain first-hand information from customers one feasible method is an in-depth interview. This fits well into the scope and time limitation of the research. Thus, the in-depth interview was chosen as the key customer requirements and data collection method. Participants observation method focuses on collecting data on naturally occurring human behaviour and focus groups method collects data on cultural norms of larger groups and subgroups. (Mack et al. 2011).

An in-depth interview is an effective technique to provide a picture of the interviewee's view on the research topic. In the interview, it is important that the interviewer asks neutral questions and listens carefully to the interviewee's responses. At all time, in case the responses are somewhat unclear it is important to clarify responses by asking for clarifications and probing based on those responses. Typically, the in-depth interviews are conducted as face-to-face and participants in the interview are the interviewer and interviewee. Due to the geographic challenge related to the distance between the interview participants, the interview of case company key customer was conducted as a Skype call interview. (Mack et al. 2011).

Before the interview starts, it is important that the interviewer explains that the purpose of the interview is related in a broader context to the research project. The interviewee shall be assured that all that they say will be confidential and anonymous. (Mack et al. 2011). This will increase the trust of the interviewee and this will have a positive impact on the quality of the data collected. It is recommended to inform the interviewee that only the study supervisor will have visibility to the notes and thus it is good to inform in writing the name of the supervisor of the research. Sometimes it is necessary to sign a Non-disclosure agreement prior to the interview however in this research interview, the case company and the customer of the case company had already an agreement signed as part of the commercial contracts between the companies.

The interview data includes tape recordings, typed transcripts of the recordings and of course the notes that the interviewer makes during the interview. Taking notes should take place even if the interview is recorded. (Mack et al. 2011). It is recommended to design an interview protocol or question guide that act as a guide for the interviewer into which the interviewer can make notes directly below the question in the guide. These notes are recommended to be expanded right after the interview so that while the items are fresh in memory, it is easier to expand the notes. (Mack et al. 2011). The interview guide can have either generic topics that will be covered or more detailed questions.

In addition to the interview guide and notes, one can also use images in the interview as a tool to facilitate the talking at the interview. This is also called elicitation. As an example, there are two elicitation techniques: graphics and photos. Some researchers suggest that using photos or graphics gives the interviewee more authority. (Edwards et al. 2013). Photo elicitation stimulates, visualizes, extends and augments the interviews more than only words or text. Graphic elicitation methods are used to visualize for example time-lines or other relationships between issues related to the theme of the interview. (Edwards et al. 2013).

During the interview, the interviewer observes also the meanings that the interviewee might be signalling "between the lines" which is good to clarify with "implicit message" with the aim of obtaining clarification of the interviewer. In this way, the interpretation of the interviewer gets confirmation or disconfirmation at the time of the interview instead of having to ask for clarifications later. (Steinar 1996). In this regard, it is also important that the interviewer tries to gather information from the interviewee as presuppositionless as possible combined with possible deliberate naivete since this implies an openness at

the interviewee. Furthermore, it is good for the interviewer to be critical and sceptic of his or her own hypothesis during the interview. (Steinar 1996).

3.3   Creating roadmaps

This chapter describes and illustrates some fundamentals when creating business roadmaps in general and how to build a visually clear and useful business roadmap. The roadmap is planned to be used as a tool in the development of the company strategy. Developing company strategy is not within the scope of this research.

Creating roadmap techniques is not the main purpose of the research since the business roadmap is just a tool summarizing and visualizing the identified high level of business and technology trends which are seen as important for the case company in the next 2-3 years. The aim is to collect and summarize into the roadmap the trends and drivers of change that the case company is, based on this research, recommended to consider when developing its software products, services, and business models.

The case company is a software developing company and it has its own software product that it develops and maintains. The scope of this research is not to investigate in detail the case company's software product development and technical requirements. Furthermore, the case company has already a solution roadmap including the case company's software product and the underlying hardware and system software related technology elements. These two technology elements including the related technology standards are not in detail in the scope of this research. However, there can be some identified trends and drivers that have an impact on these elements and will, in that case, be considered to be included in the business roadmap.

The technology delivers strategic important value and competitive advantage to enterprises. The importance of this increases when the cost, rate of new technology changes and competition increases globally. Thus, the management of the new technologies that the business benefits from, requires from the enterprises an effective process ensuring the enterprises can benefit effectively from the new emerging technologies. (Furrukh et al. 2003). Particularly important is evaluating the new technologies, the opportunities, and threats as well as the market impact of the emerging potentially disrupting technologies. (Furrukh 2004).

A technology roadmap is a powerful tool that supports the enterprises in developing and implementing new products and services. The roadmap is also a good visual tool which helps planning the customer requirement based technologies and business plans. Furthermore, a road map is a business plan that fits short and long-term business targets with practical solutions to meet the goals. Road mapping used in enterprise strategic planning enhances also the communication and collaboration between different stakeholders inside the enterprise. Stakeholders, in this case, are for example technologists, engineering, procurement, marketing and management inside the enterprise. Accordingly, a roadmap identifies critical new emerging technologies to all stakeholders including the senior executives, helping them to identify possible gaps in the enterprise resources and required actions to fill the gaps with for example partnering or acquisitions. (Jurgens-Kowal 2011 and Furrukh et al. 2003)

Technology roadmaps typically visualize three important strategic elements: customer and market needs, products and services and technologies. (Furrukh et al. 2003). To achieve effective business planning, researchers suggest that technology and business strategies should be developed simultaneously and not independently from each other. This ensures that the enterprise can align the activities and resources effectively to build a sustainable competitive position in the markets. (Furrukh et al. 2003).

There are eight types of roadmaps in terms of the purpose: Product; services and capability; strategic; long-range; knowledge assets; program; process and integration planning. Similarly, there are eight types of roadmaps related to the graphical format of the roadmap: Multiple layers, bars, tables, graphs, pictorial representations, flowcharts, single layers, and text. (Furrukh et al. 2003).

Typically, enterprises use multilayer road maps combining several dimensions such as time, layers, annotation and process. Time dimension can be for example short or long term with time granularity such as six months, annual or just short, medium and long. The layer is the vertical axis which needs to be designed to fit the needs and the issue being addressed. The annotation can include for example linkages between the roadmap objects; market drivers and trends; notes and colours identifying decision points; opportunities; and threats. Process means in this context the actual implementation and use of the road map as a tool in the enterprise. (Furrukh et al. 2003).

Generally, when enterprises follow a road mapping process, they need to observe that it is important to update the roadmap periodically, for example annually. In this context it is also imperative that the senior management supports this roadmap process since it will require the approval of resources, such as time and facilities. (Furrukh et al. 2003).

The below Figure 8 illustrates the aforementioned dimensions in a form of generic technology roadmap.
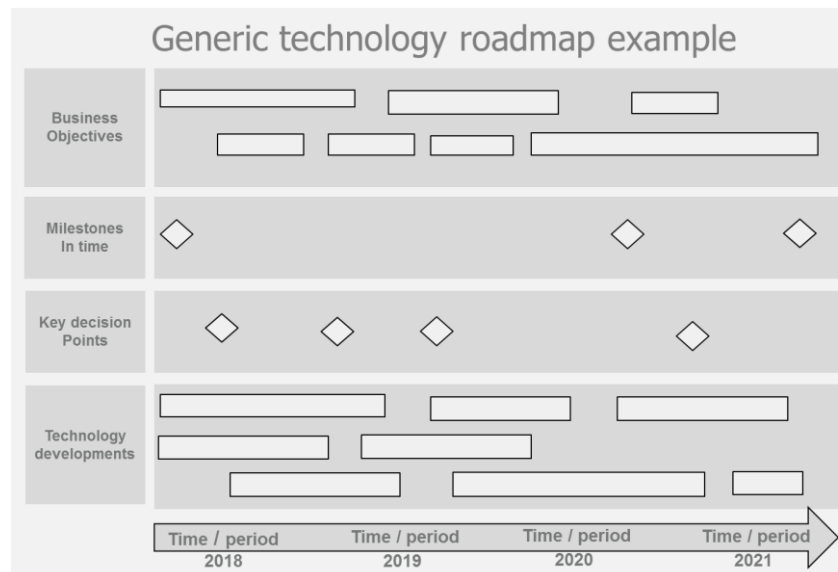
Figure 8. Generic technology roadmap example

The above example illustrates well a roadmap which is multi-layered and which reflects the synthesis of technology, business decisions, and business goals, all measured in time or period of time. (Jurgens-Kowal 2011).

In this context, roadmaps can visualize three important strategic elements used in strategy development: key customer and target market area needs, products and services as well as technologies. (Furrukh et al. 2004).

Since each enterprise is different in terms of the business, culture, processes, resources, technologies, and products, it is feasible and beneficial to customize the road maps to suit the enterprise for their own specific purposes. (Furrukh et al. 2004). Accordingly, the researcher decided to use a customized road map tool in this research.

3.4   Conceptual Framework

This chapter describes the conceptual framework as a synthesis of the methodologies and tools found from the literature. These tools and methods will be used in the next section 4 to identify the drivers of change and customer requirements. The conceptual framework diagram in Figure 11 illustrates the flow of the project steps using the chosen tools.

3.4.1   Issues-priority matrix

The chosen tool has two dimensions: development probability and the impact on the enterprise. The idea is to first rate the selected and quantified trend with a value which reflects the probability that the trend will develop into a significant level. In the scope of this research, this means how probable it is that the trend will be included in the business roadmap. The second step is to measure how strong impact the selected and rated trend could have on the enterprise. The metrics of the granularity are: high, medium and low for both dimensions. (Pilkhan 2008). A trend that is ranked as the highest priority, both probability of a trend to develop into an issue and to have a high impact on the enterprise are assessed as high. If both would be assessed as low, then the trend would be ranked as low priority. The trends between would be ranked as a medium. Pilkhan 2008).

The next step, once the trends have been placed into the matrix, is to pick up the most interesting trends for further analysis and evaluation. In this research, the highest ranked trends will be chosen to the business roadmap proposal. The others will be evaluated separately if to be included or not.

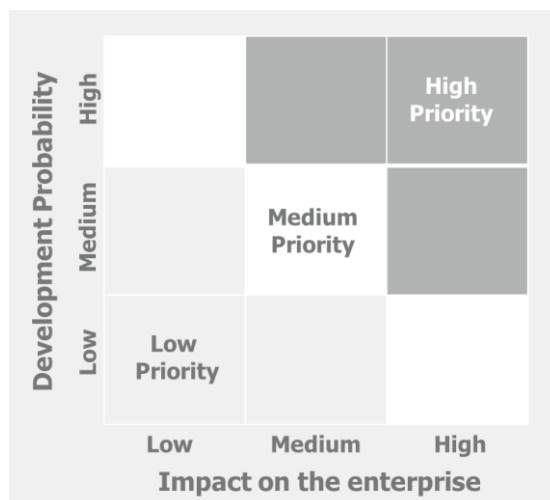The medium ranked trends could be evaluated further however that is not within the scope of this research.

Figure 9. Issues-priorities matrix, evaluation of probability. (Pilkahn 2008)

The matrix will be filled with the quantified trends and key drivers in table 1.

3.4.2   Interview guide

In this research interview guide, the questions were designed by the researcher with the help and input of employees of the case company. This approach is supported by researchers since the researcher and the employees of the case company have a good understanding of the purpose of the research which is important when analysing the business and technology requirements. (Elgendy 2016). Furthermore, the aim of the interview is to clarify what the case company's customer business needs are to be able to identify and define what new capabilities are required. (Elgendy 2016).

The themes were subjectively chosen by the researcher based on the business, technology and customer knowledge of the researcher.

The principal theme of the questions is based on the business challenge according to section 1.2 of this research. The aim of the interview is to collect data from the interviewee by asking the questions designed around the business challenge and the business environment of the case company and its customer.

In a semi-structured interview, the guide includes topics and questions that will be asked from the interviewee. The semi-constructed interview guide below will be applied in the case company customer interview. A graphic elicitation tool will also be used in the interview.

Interview guide	
Date and time of the interview	
Interviewer name:	
Interviewee name:	
Introduction of the purpose of the interview:	
Confidentiality and anonymity clarification to the interviewee	
Background information (graphic elicitation)	
Theme/Questions	**Answers, possible probes, and notes**
Theme 1	
Question 1	
Question 2	
Question 3	
…	
Question n	
Theme 2.	
Question 1.	
Question 2.	
Question 3.	
…	
Question n	
Theme n	
Question 1.	
Question 2.	
Question 3.	
…	
Question n	
Ending the interview with ending questions	
Notes, approval and follow up	

Table 2. Semi-structured interview guide

Accordingly, the most suitable technique is to conduct an in-depth interview with a key customer following the interviewing and data collection practices from the literature. Following researcher's recommendations, the interviewee who was chosen is a senior procurement representative who has an experienced and professional view of the high-level business and technology requirements. (Smith 2000). Considering the scope of this research and the long experience of the interviewer, only one interview lasting one hour was conducted. The interview is somewhat subjective since the researcher in an em-

ployee of the case company so the design of the interview guide is based on the experience and existing knowledge of the interviewer. The interviewer's aim was, in any case, to follow the researcher's recommendations to try and be as neutral, objective and presuppositionless as possible. (Steinar 1996).

Once the interview has been conducted, notes, note expansions, and transcripts have been finalized, the next step is to analyse the data.

The data analysis of the interview expanded notes is subjective since the interviewer is an employee of the case company. The aim is to collect first-hand data related to the business and technology trends and requirements that the case company customer sees as important in its business environment. In addition, the aim is to compare the business and technology trends from the IT industry related business and technology whitepapers to the prioritized requirements from the case company customer.

3.4.3 Business roadmap tool

The customized business roadmap tool illustrated in the below Figure 10 will be used and applied in this research. All the identified business and technology trends and key drivers for change, as well as the customer requirements, all prioritized with the issues-priority matrix in Figure 17 in Chapter 4, will be collected into this business roadmap. This business roadmap will be validated in the third context by a senior executive who has held several executive positions in a Finnish Telco belonging to a Nordic Telco enterprise. This executive has an experienced view of various high technology Telco business support systems including the case company OCS and related business environments. Accordingly, his feedback will be evaluated and summarized in Chapter 6.

This input from the Finnish executive will be considered when building the final business roadmap.
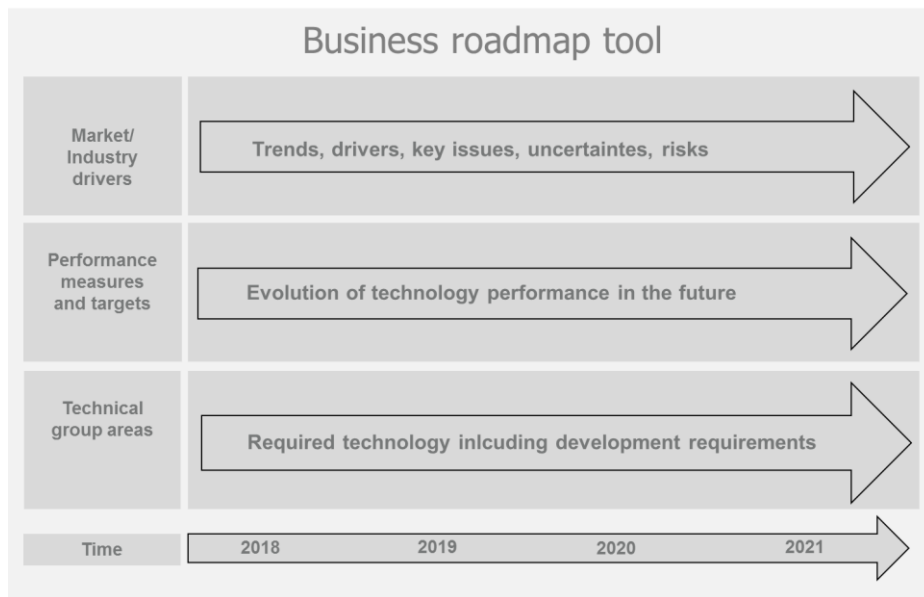

Figure 10. Business roadmap tool

The above business roadmap tool will be formed to its final graphical outlook once all the quantified, prioritized and validated data have been inserted into the tool.

3.4.4 Conceptual framework diagram

The conceptual framework in Figure 11 illustrates the flow of the research process from the literature review to identify the key business and technology trends and customer requirements and further to co-creating and building the business roadmap for the case company. This is done by using the methods and tools which are selected based on the existing literature. The business roadmap is then filled with the selected key business and technology trends and the key customer business and technology requirements.

This final business roadmap includes recommendations for the case company to consider in the future planning of its product, services and company strategy.
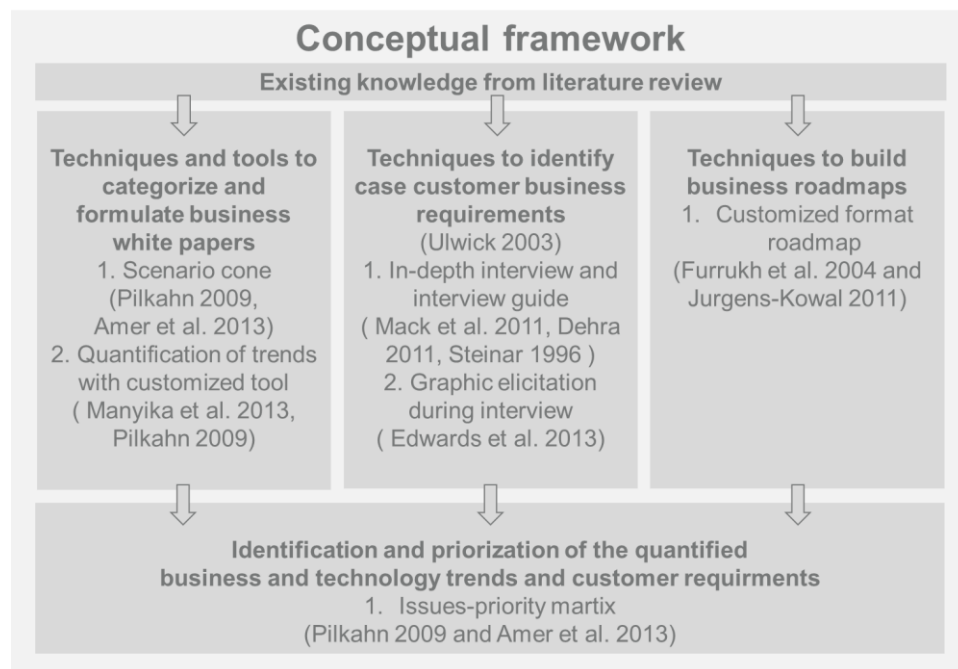

Figure 11. Conceptual framework diagram

The next chapter represents the current status of the case company in regard to the cloud technologies and aims to identify the key business and technology trends and drivers for change as well as the key customer requirements.

4 Identifying drivers of change and customer requirements

4.1 Overview of this section

The current business environment which the case company lives in is highly dynamic and is going through major changes in the next 2-5 years. 5G technology and related new services and applications such as the IoT is at our doorstep and these are just a few of the new technologies that are about to change the way people live their lives at home and at work. Some trendsetting papers and media are claiming that the 5G and IoT are the main drivers for the next industrial revolution. This will cause the case company's business environment to change dramatically. The new technology related data and information amounts are increasing at high speed and it is not easy to follow up and list down the relevant trends from this huge amount of dynamic information flow.

To be able to identify and choose relevant business and technology trends and drivers for change, the research angle and business areas need to be scoped. The case company develops a real-time OCS software product for Telcos and this point of view, will be considered when trends are collected and chosen. The goal of the case company is to exercise sustainable long-lasting business. Thus trends that could potentially create new revenue streams and increased competitive advantage are the most lucrative to the researcher. One additional element that will be considered is the 3GPP 5G and data charging standard guidelines for the OCS solutions. This is because the 3GPP standards related to data charging continue being especially important for the case company business and to the case company's customers.

In this section, the trends and driving forces will be chosen by the researcher based on the business environment knowledge of the researcher. Since the researcher is an employee of the case company, the selection of trends is subjective. The time frame of the business and technology trends is 2-3 years until about 2020 -2011. 5G has been discussed in many sections however only 5G new services and trends related to OCS or the case company will be evaluated. The chosen and then quantified business and technology trends and customer requirements will be analyzed and prioritized using the issues-priorities matrix and the highest priority trends and future business-related drivers will be qualified to be included in the case company business roadmap.

4.2   Identifying key drivers and trends of OCS and its technology and business context

The business challenge is that the case company OCS does not yet support cloud-based technologies. Furthermore, the possible impact of surrounding business and technology key trends to the case company product and business models is unclear and for this purpose, the objective is to collect and summarize key trends and customer requirements into a business roadmap. This roadmap will act as a tool when developing company product technology and business strategies and it visualizes the trends and drivers to follow closely in the next 2-3 years.

The first trend that actually can be considered as megatrend is 5G technology. The introduction of 5G networks will increase exponentially the growth of data and with this in mind, 5G is the biggest megatrend of today impacting the case company OCS. There are trends and drivers that are related to 5G technology and these will be handled separately. However, since 5G's full business potential and variety of applications and business models are still unknown, the 5G is also considered as a separate trend.

As data related services have become the main revenue stream for Telcos and CSPs, the importance of real-time OCS data charging capabilities has increased at the operators. The more data, the more real-time control is required to ensure the monetizing potential that there will be.

The second chosen item into the list of candidates to be included in the business roadmap, as driving force for change, is the 3GPP standards related to 5G requirements for OCSs.

Currently, the case company complies with 3GPP TS 32.xxx standards. The triple x means here that there are several sub-standards under the technical specification number 32. The case company OCS has additional functional charging capabilities via own proprietary interfaces. The case company OCS has, in addition, numerous other capabilities, functionalities and added value but these are not within the scope of this research.

The reason for the below listing of 3GPP OCS related requirements is to gain a general understanding of the level of current support of the case company OCS compared to the standards. In addition, one of the specific driving force to choose the 3GPP standards evaluation to this research is the impact of 5G technology to the data charging requirements. This said and since the case company follows the standards, 3GPP standards are chosen as a candidate to be included in the case company business roadmap.

The following tables are related to 3GPP 4G standards for the OCS which will remain valid until the new 5G requirements are baselined and completed. The key capabilities of an OCS solution according to the 3GPP TS 32.xxx standard are listed in Table 3 below. (3GPP 2018).

Mechanism to be supported in OCS today
1. Online bearer charging towards access/core network entities (e.g. SGSN, PCEF, TDF). Online charging interfaces to be supported are Ro and CAP;
2. Online charging of applications/services that are provided to subscribers via service nodes (outside the core network) e.g. MMS and LCS. The online charging interface to be supported is Ro;
3. IMS online charging. Online charging interface to be supported is Ro;
4. Account balance management towards external account management servers e.g. recharge server, hot billing server;
5. Generation of Charging Data Records (CDRs) and their transfer to the operator's post-processing system;
6. Spending limit and balance monitoring and reporting based on subscription or configuration within OCS, towards Policy and Charging Rule Function.
Optional mechanism to be supported
1. Correlation of bearer, service and IMS charging.

Table 3. Charging mechanism requirements of an OCS according to 3GPP standard TS 32.296 version 14.0.0. (3GPP 2018).

According to 3GPP TS 32.296 version 14.0.0, the key functions to support the above mechanisms of an OCS solution are listed in Table 4 below.

Function	Description of the requirements in the OCS
1. Rating (Before and/or service consumption	Unit determination: calculation and reservation of a number of session-related non-monetary units (Service units, data volume, time and events)
	Price determination: calculation of monetary units (price) for a given number of non-monetary units
	Tariff determination: determination of tariff information based on the subscriber's contractual terms and service being requested (e.g. information for AoC);
	Get/set counters applicable for rating (alternatively these counters can be here or in the subscriber account balance management; for further details refer to clause 5.2.2).
2. Subscriber account balance management:	Check account balance;
	Account balance update (credit/debit);
	Account balance reservation;
	Get/set counters;
	Get/set expiry date of the (pre-paid) account (optional).
3. Charging transaction control:	Perform charging control on request basis for bearer and events/services;
	Immediate charging and charging with reservation;
	Generation of charging information/CDR per charging transaction.
4. Advice of charge support (defined in TS 32.280 [40]):	Receive tariff information from external system;
	Provide Advice of Charge (AoC) information (tariff and/or cost).

Optional function	Description of the requirements in the OCS
1. Correlation function	Context handling of bearer, service, and IMS charging events related to a given subscriber;
	Generation of a combined multiple event and session requests to the Rating Function.
2. Notification management	Monitor account balance and/or counters thresholds;
	Session management of notification subscriptions for a given subscriber;
	Mapping of account balance and/or counters thresholds to notification statuses (e.g. policy counter statuses);
	Report changes in notification statuses for a given subscriber;
	Respond to queries of notification status values for a given subscriber.

Table 4. Functional requirements of an OCS according to 3GPP standard TS 32.296 version 14.0.0 (3GPP 2018).

Furthermore, the case company complies with the following specific data charging related 3GPP standards:

3GPPP standard #	Type
3GPP TS 32.299	Diameter charging
3GPP TS 32.251	Data (PS domain) charging
3GPP TS 32.270	MMS charging
3GPP TS 32.274	SMS charging
3GPP TS 32.260/275	IMS/MMTel (VoLTE) charging

Table 5. Additional data charging capabilities related 3GPP standards that the case company complies with

In addition to the above 3GPP standards, the case company has developed additional own proprietary interfaces and data charging capabilities according to special requirements from the customers. This information is however confidential and it is not within the scope of this research.

Accordingly, the OCS reference architecture according to 3GPP is illustrated in figure 4 below.
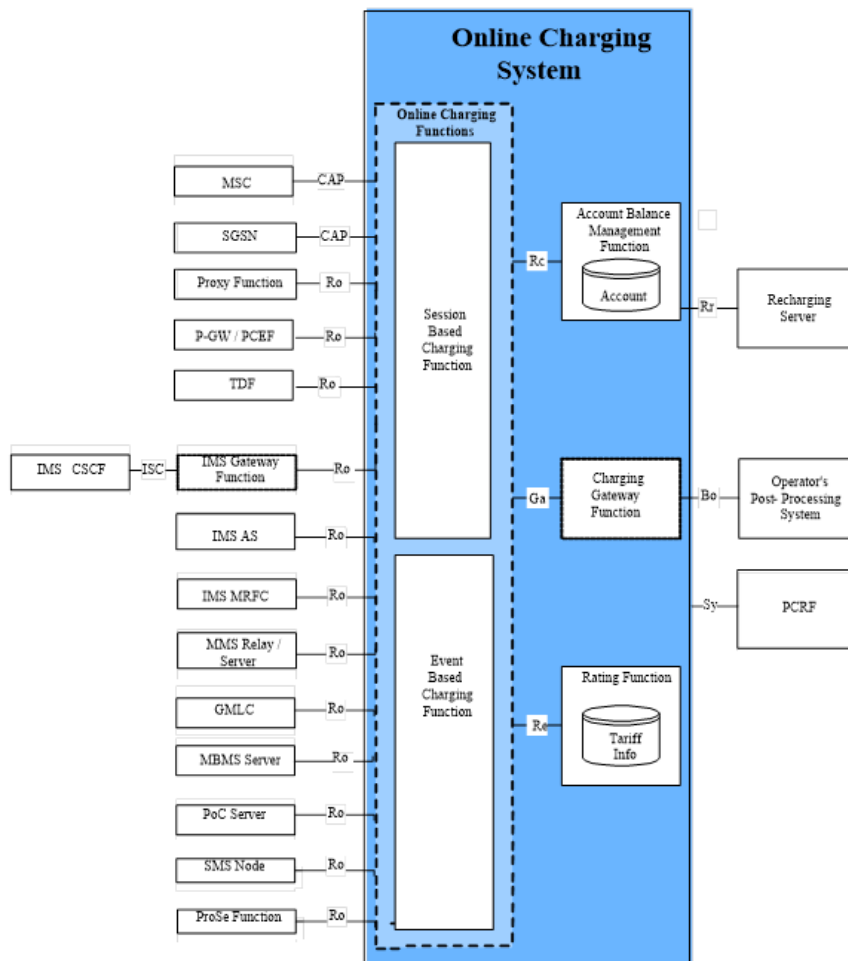

Figure 12. The reference architecture of an OCS according to 3GPP standard TS 32.xxx

The case company OCS complies with all major interface requirements illustrated in Figure 12 above. Further evaluation of the interfaces is not required to be included in the scope of this research.

The first technical key aspect for the case company is the 5G related requirements for the data charging according to 3GPP standards. These 5G related standards for OCS are not yet completed and defined however there is a 3GPP study on the charging aspects of 5G architecture. It is recommended to follow up the development and updates from the 3GPP ongoing base.

Despite that 5G networks standards are not yet finalized, 3GPP has started already with evaluating the possible changes to the OCS technical requirements to fulfil the requirements related to charging of 5G new services. Earlier defined 3GPP high-level charging requirements related to LTE TS 22.115 remain valid in 5G and to high light some of the main requirements, the following shall be supported also in the future. The LTE means Long Term Evolution which is a 4G mobile communication standard for data. (3GPP 2018). VoLTE means Voice over LTE which refers to a voice call over the LTE mobile network. (3GPP 2018).

Charging requirements for LTE according to 3GPP
1. Volume, time, combined volume and time, and event-based charging models
2. Session based charging
3. Application based charging model
4. Usage real-time control
5. capability for billing system support
6. capability for inter-operator charging
7. capability for Network operator to Third party providers charging
Optional mechanism to be supported
1. Correlation of bearer, service and IMS charging

Table 6. Charging requirements applicable for LTE that will remain valid for 5G

According to 3GPP TS 22.261 [102] there are 5G networks requirements that are listed in the below Table 7. These requirements have not been finalized and are subject to change.

Charging requirements supported
1. The 5G core network shall support collection of charging information for alternative authentication mechanisms
2. The 5G core network shall support collection of charging information associated with each serving MNO when multi-network connectivity is used under the control of the home operator.
3. The 5G core network shall support charging for services/applications in an operator's Service Hosting Environment.
4. The 5G core network shall support charging for content delivered from a content caching application
5. The 5G core network shall support collection of charging information based on the access type (e.g., 3GPP, non-3GPP).
6. The 5G core network shall support collection of charging information based on the slice that the UE accesses.

Table 7. Preliminary charging requirements for 5G based on 3GPP TS 22.261 [102]

Subsequently, the standards for 5G network and 5G OCS related requirements are not yet finalized and the 3GPPP standard organization is still working on these guidelines and technical specifications.

The latest study related to the 5G charging and 5G services indicated that network slicing could be one of the key potential elements for innovating 5G new services. Slicing the network bandwidth provides certain network capabilities that could be mapped to new advanced digital services. (3GPP 2018). Some global OCS vendors are suggesting as an example that new digital services per network slice could be for example augmented reality (AR), virtual reality (VR) and smart cars or self-driving cars. These are also currently seen as emerging trends and interesting trends but due to the limitation of the scope of this research these trends are only recommended being followed an ongoing base

From the OCS point of view, considering the 3GPP standards for virtualized OCS's, the OCS charging capabilities should support the 5G network slicing requirement as per the figure 13 below.
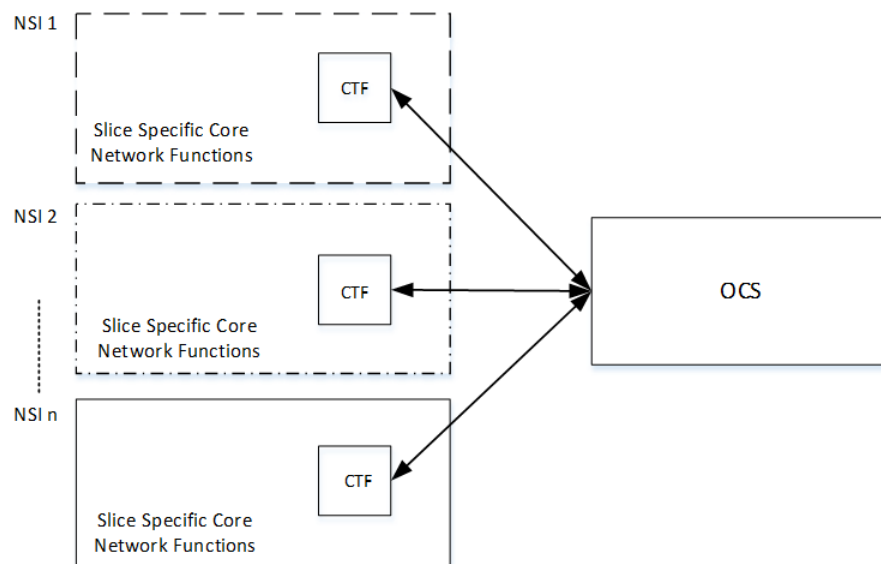

Figure 13. The OCS shared by all the Network slice instances

In the option above, the OCS is shared among the network slice instances (NSI) in the mobile network. In each NSI there could be several Charging Trigger Functions (CTS) generating information related to charging. Each NSI could correspond to slice specific new digital services such as a smart car for slice one and augmented reality based traffic for slice two.

This model is quite similar to the case company OCS multiple MVNO capability in which one OCS can include multiple MVNOs in the same deployment.

The below Figure 14 describes different requirement and approach than Figure 13.
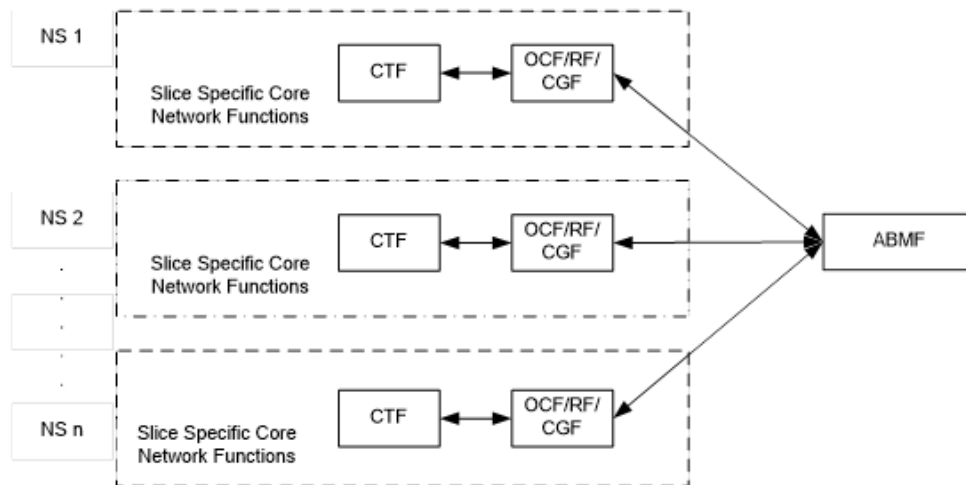

Figure 14. The slice specific OCS for each network slice

In this option, OCS should support the requirements of slice-specific configuration or deployment. As an example of a business case, in this alternative, the network operator could offer several network slice specific services to one account. In the picture above, ABMF means account balance management function as one virtual network function. Specific service per network slice, in this case, could be for example on-demand TV for slice one and smart home for slice two. The account in this example could correspond to one enterprise customer of the CSP. (3GPP 2018).

Consequently, slicing of the network enables the Telcos and CSPs to configure multiple service delivery parameters like bandwidth and latency and dedicate one service per slice. As an example, one slice for 5G smartphones, one slice for 4K video on demand and one slice for VR. (3GPP 2018). These examples describe well some new digital end-user services and technical drivers that the OCS vendors should consider in the new virtualized OCS capability development.

There are more initial requirements in the 3GPP study related to OCS and 5G. However, considering the limitations in time the further investigation is not within the scope of this research. This is a normal solution development task and will be recommended to the case company to be evaluated in more detail.

Aforementioned requirements and capabilities would potentially also create opportunities for new business areas such as for industry or digital service specific Mobile Virtual Network Operators (MVNO) to build their business on. This said 5G enables also a new type of service providers to evolve, such as digital virtual network operators (DVNO). These new DVNOs, by utilizing the network slicing capability of 5G, have an opportunity to build new business models for numerous new types of combinations of target groups and services. (Grimadlo et al. 2016).

The case company's current OCS capability of multiple MVNOs allows the Telco to provide charging to MVNOs as a service and charge the MVNOs for example on monthly base on the consumed number of minutes, messages and amount of data. This is done by collecting all the related call data records (CDRs) by the end of the month and invoice the MVNO based on these CDRs. So, this is not a new model however the 5G will bring new elements that the OCS vendors should consider in their product and business development. The OCS vendors, such as the case company, will also have new business opportunities opening to sell their OCS solutions potentially to these new DVNOs offering new 5G services and who want to have control over the real-time charging and billing part of their operations.

The classic business model of an MVNO is that they buy network capacity, billing and charging functions and sometimes also customer care as managed services from the Telco. Typically, the MVNOs manage the sales, marketing, and customer relationships part by themselves which is a much lighter investment business model not having to invest in expensive networks and OSS and BSS systems.

In some cases, once the MVNOs have grown their business enough, the MVNOs purchase their own billing and charging solutions to be able to have more control over the new service launches, customer relationship and customer value chain. In this business model, the MVNOs and new DVNOs becomes potential new customers for the OCS vendors. The virtualization might bring even more new business models in which the DVNOs would purchase their own virtualized OCS and pay to the Telcos only for the platform as a service (PaaS). This new model could increase potentially the business opportunities at the OCS vendors. As a conclusion, the DVNO is a potential new trend in the OCS business environment and should be considered as a potential candidate to be included in the case company business roadmap.

The next chosen trend is virtualization related to the OCS. The cloud technologies used in the IT industry do not comply with the telecommunications' stricter requirements. The telecommunications based cloud technology is called Telco cloud which in general is based on the same philosophy as IT cloud technology but it has certain specific requirements that are stricter in comparison to generic IT cloud technologies. For the case company, this means that their OCS products need to support virtualization and the NFV requirements. The figure 15 below illustrates the NFV high-level framework. The virtualized OCS function is marked with a red circle. VNF means virtual network function and OCS is one of the functions in the network.

Solutions such as switches, gateways, traffic analysis, signalling, routers, mobile network nodes once virtualized are also virtual network functions and the vendors of these applications have same development path ahead of them as the OCS application vendors.
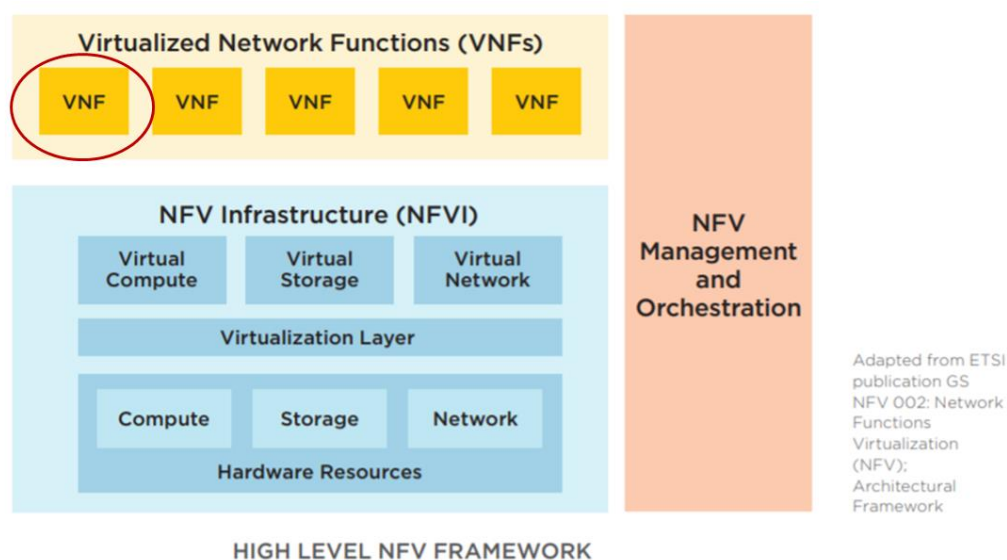

Figure 15. The high-level NFV framework illustrating the virtualized OCS position in the framework. (SDx Central 2018).

The trend of virtualization and the journey to native cloud-based technologies in one of the main technological trends in the Telco industry. As an example, one of the case company customers has made a strategic decision that 70% of their network and OSS and BSS solutions shall be virtualized by 2020. Thus, the case company's decision to develop its OCS to support virtualization technologies was grounded and now the case company needs next to further develop its OCS solution to support the virtualization software such as VMWare and Open Stack virtualization software. The virtualization soft-

ware is illustrated in Figure 15 above as the Virtualization Layer. Virtualization, in general, is a separation of a resource such as application software from the underlying physical hardware that delivers that service. (VMWare 2006). The virtualization layer provides an abstraction between computing, storage and network hardware and the application software running on top of it. (VMWare 2006).

Subsequently, the virtualization software enables to run several operating systems and applications on the same server simultaneously. The case company OCS software product can be installed onto a virtualized operative system and can run on standard X86 hardware technology. This means that the case company has finalized step one and the next step is to develop and test the OCS further to support the virtualization software. This next step is illustrated in Figure 16 below as step two in the four step path to cloud-native virtualized OCS.

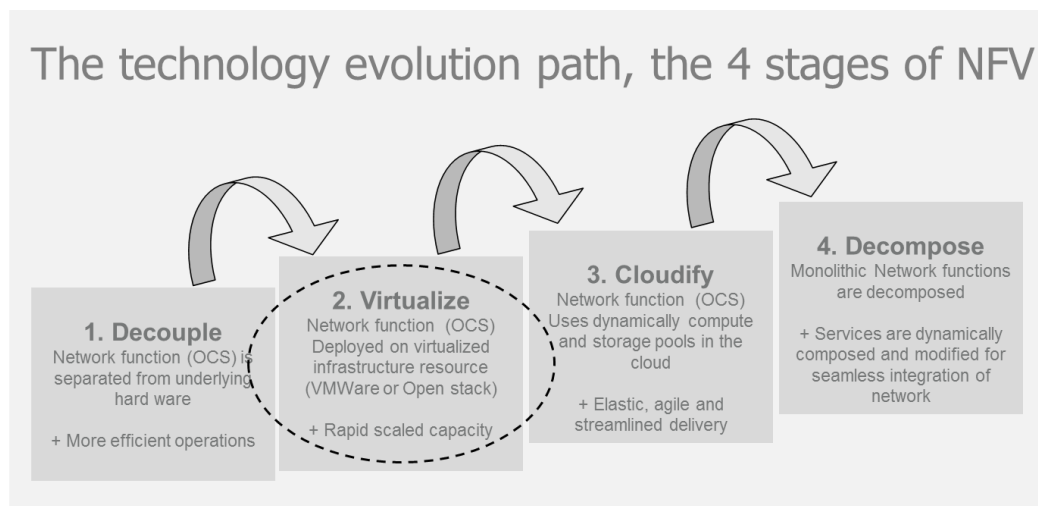The four development stages of the NFV are illustrated in Figure 16 below.

Figure 16. The 4 stages of NFV and current stage of the case company (HPE Enterprise 2016)

The path illustrated above is a clear plan however the case company needs to follow up the developments in this area of technologies closely to ensure that all possible further developments in this virtualization trend will be considered in the development of the case company OCS. The virtualization trend, as well as the aforementioned 3GPP standards for charging, are two technology trends that are especially important and has a big potential to be included in the product development and impact to the case company.

The next trend is Internet-of-Things also know in industry news and trendsetting white papers as IoT. IoT could also be defined as a mega trend similar to 5G and it has big business potential once the 5G networks are enabled to deliver the required capacity for large full-scale implementation of IoT.   Virtualized networks, cloud computing, and the data centres have a big role enabling the IoT to be a success. (Sdx central 2018). The estimates are that potentially billions of devices will be connected via the internet to each other. The basic idea is that people can communicate with devices and devices can communicate with each other. Devices are also referred to as machines. (Sdx central 2018).

The business potential of the IoT is big for the Telcos and service providers and also to the vendors providing applications and solutions that enable to manage and deliver the services to end customers. Researchers are reporting that more than 75% of the enterprises of all sizes indicate that IoT is critical to their future success in business. (Sdx central 2017). This will be a challenge since the markets are so big and fragmented and this is causing also big concerns related to standards and numbers of platforms for the IoT. The players in this market are the Telcos, CSPs and companies like Amazon Web Services and well as Google and Microsoft. (SDx central 2017).

Technology concerns that need to be solved are for example the low power wide area (LPWA) technologies that would enable to provide devices with a battery life over 10 years. Furthermore, 5G technology with low latency and high capacity opens business opportunities to the CSP which provided the necessary data transport infrastructure. (SDx central 2017).

The enterprise IoT drivers are typically related to greater operational effectiveness and better utilization of their assets. As an example, a big Chinese energy company was able to improve its productivity 15% by cutting time between collection and analysis of data with sensors on their 20 000 wind turbines. (SDx central 2017). IoT has potential through a business transformation to create new business models. As an example of this is Xerox which has transformed from printer manufacturer into a product as a service technology company. Furthermore, according to Vodafone IoT barometer, enterprises see enhanced customer and user experience as one of the top benefits of IoT.

For Telcos and CSPs the IoT opens new opportunity to take their stake in cellular-based technologies that enables delivering IoT device connectivity cost-efficiently. Telcos need

to utilize this opportunity by including the IoT capability into their ecosystems so that they can innovate new business and increase their part in the overall business. As an example, many Telcos have opened numerous innovation programs related to IoT and other new technologies with the aim of developing new consumer and business services. (SDx central 2017). Some Telcos have seen also opportunities in opening their networks and IT systems for application developers which potentially can open new business areas and growth in their revenues. This service that the Telcos are offering is called Platform-as-a-Service (PaaS) and according to Gartner, more than 50% of the new software applications developed on PaaS will be related to IoT. (Gartner 2017).

To quantify IoT, the estimated global IoT markets is estimated to grow by 28.5% GAGR totalling 457 billion US dollars in the year 2020. The biggest verticals inside this market are manufacturing, transportation and logistics and utilities. Each of these verticals is estimated to spend 40 billion US dollars each. (Columbus 2018).

According to GSMA report, there will be 25 billion cellular and non-cellular IoT connections in 2025. (GSMA 2018). There will be about 18 billion IoT devices connected by 2022 and 1.5 billion devices with a cellular connection. The growth is due to industry focus and since 3GPP will standardize the cellular IoT Technologies. (Ericsson 2018). The case company will follow the development of this standard closely.

Consequently, the charging of IoT related services, whether it being directed to consumers or enterprises, the case company is required to be able to charge in real time these types of services. The business environment in this field seems to be growing to also other industries such as utilities, healthcare, and manufacturing. Thus, the case company needs to have an open mind to expand its business environment and the product development need to understand the broader picture as well.

4.3   Identifying case customers business requirements

The interview of the case company customer was conducted and there were several new insights and views that were valuable and potential future capabilities that will be considered.

The interview started with the introduction of the purpose of the interview and was followed by clarification of the confidentiality and anonymity. Then at the beginning of the

interview, two graphical diagrams of the case company status related to the OCS virtualization was sent during the interview. The graphical pictures sent to the interview included the same illustration than in Figure 7 and Figure 8 in this research. This was very useful so that the interviewee understood better the scope of the research and the development status of the case company OCS.

The next step was to start with the questions and initially, the interviewee knowledge of the case company solution was clarified. The interviewee knows the case company and its product well however he did not have too deep technical knowledge about the OCS technologies. This was not a problem since the questions were on a higher level and no technical specification level of knowledge was required.

Due to the confidentiality of the interview, only some high level of business and technology trends and drivers for change can be shared. Some of these shared are actually mentioned in the customer annual report so these are public information. There were other confidential items that came up during the interview but since they were not related to the scope of this research, the expanded notes cannot be shared.

The requirements of the case company customer are quite similar to many other Telcos and following the trends in the industry. Virtualization and NFV are seen as important elements however depending on which market the operators act in, there are still many areas of technologies that can be further utilized prior to using the latest technologies available. In emerging countries in general, the penetration of smartphones is still quite low. According to GSMA the penetration of 4G smartphones is 37% (GSMA 2018) and in the case company customer, it is 26%, however growing rapidly.

Accordingly, the growth of 4G connections is creating new business opportunities for bundled service offers which are still in many countries a leading market trend for Telcos. There are numerous types of application based service packages as well as three or four play packages including mobile, broadband, on-demand TV, and fixed line. These type of offers, as well as special daily offers, are still quite popular even in the developed countries.

The case company OCS includes an MVNO capability and this is still considered as an important functionality. There seem to be requirements for enhanced capabilities for the MVNO capability, thus this item needs to be evaluated further.

The cost reductions of OPEX and CAPEX are important however also the OCS functionalities to be able to offer new services with a short time to market are seen as important. This supports the continuation of the rich functionalities development in the case company.

Furthermore, the case company customer sees that the technology partners are not only expected to provide new enhanced technologies but also right business models. The software vendors are not only requested Software as a Service (SaaS) but also the right type of enhanced rich partnering and business models. The idea with this model is that the Telco defines the technology and business key performance indicators (KPI) and this acts as the base for the partnership. Some level of development resource sharing could be part of this model. The reasoning for this is that the case company customer also feels that the new technologies develop quickly and situations are dynamic and hard to follow. This key driver for change will be called Anything as a Service (XaaS) for the purpose of further quantification and evaluation in this research.

In regard to licensing models, currently the typical license model is subscriber based and the number of subscribers has an impact on the OPEX and CAPEX. The needs in the future will be moving towards managed service direction which means that there is just one cost per month. The needs are also moving to all in one licensing type which means in this case that all the services including mobile, broadband, fixed telephony and on-demand TV would consist of only one subscription and that the monthly service would be based on this type of bundled subscriber license type. For the case company, this would mean in general that one subscriber account would include all these services under one license.

Customer self-service (CSS) is an important part of Telcos' operations and an element of successful and sustainable business. The case company customer view is however that the importance and possibility to monetize advanced CSS services would greatly depend on the markets and the business environment where the Telco operates.

In this respect, related to the OCS, there are several new technologies that are investigated and evaluated for example in the area of Interactive Voice Response Systems (IVRs). IVR is a technology that can read a combination of touch tone and spoken voice input which are typically given via phone. This gives the subscriber access to a database

of information which is categorized into several menus of prerecorded options that the user can choose from. (Techterms 2018). The new technologies that could potentially be used in this type of enhanced services are bots and AI. A bot is an automated program that runs and searches information over the internet. Bots can be automated or executable when they receive a specific input. (Techterms 2018). AI means Artificial Intelligence (AI) and as an example, Amazon uses in its business machine-learning systems (a subset of AI) and they define it as the area of computer science that helps to solve cognitive problems commonly associated with human intelligence related to learning, problem-solving and pattern recognition. Practically, this improves Amazons customer experience and selection as well as optimization of logistics speed and quality. One of IBM's focus area of applying AI is in natural language processing and speech and image recognition. (Marr 2018). The above new technologies indicate the areas that the Telcos are also looking into when trying to innovate new services that they potentially could monetize and increase their customer experience which is the base of the sustainable business model. The impact to the case company related to AI and bots would be more on charging capability of external digital services. This trend will be named as AI in the further quantification and evaluation in this research.

The latter part of the interview related to the importance of 5G and IoT to the case company customer. The markets where the case company customer acts are in emerging markets and the penetration of 4G is still just under a third of their customer base. The penetration is increasing with two-digit numbers per year, thus the importance and potential of 4G is still big. The new 5G technology obviously is important to the customer, however the business environment needs to develop still before there will be full use of the technology. The situation with IoT is similar meaning that the technology and business cases are evaluated but the timing in emerging countries is not probably yet right. Furthermore, the main driver for 5G to the customer, similar as to many other Telcos operating in emerging countries, would be to demonstrate that new technologies are followed and available but the markets still need to evolve to bring full business benefit out of the new technologies.

The interview was formally ended and the next steps were agreed. The interviewer committed to sending the notes of the interview to the interviewee for approval which was received soon after the notes had been sent. The approval of the notes was also sent to the supervisor of the research to verify that the interview was conducted and the notes had been approved.

4.4   Quantifying and prioritizing the selected trends and key drivers for change

As a summary, the selected trends and key drivers for change from chapter 4.2 and 4.3 are quantified in Table 8 below. There is some overlapping of items from the selected business and technology trends and key drivers for change from the chapters 4.2 and 4.3. These overlapping items will be combined into the same trend (T1, T2, T3,…Tn) category in the table 8 below. There are also numbered references in the table which are listed after the table. The corresponding references can be found from the reference list of this research at the end of the document.

Trend # and definition	Business potential and value (USD)	Number of users	Case company grading (1-3) 3 being most important
T1 5G	The 5G market total value in 2020 is 251 billion USD. 1.)	In 2025 1.26 billion users in 5G.	3
T2 3GPP standards related to OCS	Estimated Revenue management market size in 2020 is 22 billion USD. OCS is part of this category. 2.)	There are estimated 1690 mobile operators globally in 237 countries in the world. 3.)	3
T3 Virtualization	The virtualization market total value in 202 is 22 billion USD. This includes Software defined networks, NFV and virtualization ecosystems. 4.)	In 2025 1.26 billion users in 5G.	3
T4 NFV	NFV market total value in 2020 is over 15 billion USD (Sdx Central 2018). 5.)	In 2025 1.26 billion users in 5G.	3
T5 5G OCS requirements (Network slicing)	The 5G market total value in 2020 is 251 billion USD. 1.)	In 2025 1.26 billion users in 5G.	2
T6 DVNO	MVNO business value in 2017 was 54.1 billion USD. The estimated business value in 2022 is estimated to be 88 billion USD. 6.)	Number of MVNOS according to GSMA is over 1200 in 237 countries.	2
T7 IOT	IOT total market total value is 457 Billion by 2020. 7.)	Number of IoT devices and cellular devices 25 billion in 2025.	2

T8 AI	AI (including machine learning ML) market in 2021 total market value is 57.6 billion. According to Gartner, the total global business value is estimated 3.8 trillion in 2022. 8.) and 9.)	AI and ML according to MEMSQL research 61% of companies find AI and ML most important data initiative in their companies for 2019. 10.)	1
T9 4G Services (OCS 4G enhancements and multi-play bundles)	4G wireless infrastructure market in total value was billion in 2017. Top 25 4G mobile operators service revenues were 1167 billion Euros in 2016. 11.) and 12.)	4G subscribers in total are 4.7 billion by 2020.	2
T10 XaaS	For the scope of this research relevant SaaS Cloud Application Services market total value is estimated to reach 75.7 billion USD in 2020. 13.)	30 % of 100 largest new software investments will be SaaS-based by 2019. 13.)	2

All the data in the table above according to GSMA (2018) except:

1.) Global Newswire (2018) (T1 and T5)

2.) Marketsandmarkets (2016) (T2)

3.) Mcc-Mnc (2018) (T2)

4.) Cision PR Newswire (2018) (T3)

5.) Carlson, W. (2016) (T4)

6.) Costello, H. (2018) (T5)

7.) Columbus, L. (2017) (T7)

8.) Columbus, L. (2018) (T8)

9.) Gartner (2018) (T8)

10.) MEMSQL (2018) (T8)

11.) Statista (2018) (T9)

12.) Globe Newswire (2018) (T9)

13.) Gartner (2017) (T10)

Table 8. Quantification of the trends and customer requirements.

These quantified trends and drivers will be prioritized in the next chapter.

4.5   Summary of change drivers identified

This chapter will summarize and prioritize the quantified trends and key drivers for change from chapter 4.4. using the issues-priority matrix.

Figure 17. Identifying the highest priority key business and technology trends

The listed trends T1-T10 were inserted into the matrix and evaluated in the matrix above in two aspects. The first aspect is the probability or possibility of the trend to be developed and included in the case company product in the future. The second aspect is how big the business impact of the trend is to the case company in general. The estimation of the 2 aspects is relatively subjective since the researcher is an employee of the case company. This said the researcher has deep knowledge of the case company business environment and the OCS product which makes this subjective decision reliable in the scope of the case company.

The results of the matrix above can be summarized as follows. There are no trends in the lowest left corner of the matrix. The trends T2 (3GPP standards related to OCS) and T3 (Virtualization) are the highest priority and should have the highest priority for the case company. These have both of high probability to be developed into the case company OCS and have the biggest impact on the case company business. The T4 (NFV) and T9 (4G Services) trends have a medium impact to the case company but have high importance to the OCS product thus should be included into the business roadmap. The T1 (5G) and T6 (DVNO) have in contrast only medium priority in regard to the OCS product but a high importance to the company business. The T10 (XaaS) trend has almost no importance to the product but due to highest impact on the business models

related to case company business operations, it shall be included in the business roadmap. Considering that the T5 (5G OCS requirements) and T7 (IoT) trends are related to megatrends these must also be included into the roadmap and finally, even the last trend T8 (AI) is recommended to be included since this can potentially increase its priority once AI develops further and becomes a more concrete opportunity for the future business of the case company.

Accordingly, all prioritized trends will be selected to the business roadmap. Supported by the researchers, the priority will be highlighted in the business roadmap with different colors illustrating the priority of three categories.

As a summary, the categorized trends are listed in Figure 18 below.

Figure 18. Trends categorized in priority and colour

The next step is to build the business roadmap accompanied by the business perspective and opportunity definition relative to the case company. This will be done in the next chapter.

5 Co-Creating the Road Map

The business roadmap, the proposal, has been created with a hybrid approach. The key technical expert, system architect of the case company has been participating in the modelling of the roadmap design. The business roadmap first draft was made by the researcher and the expert gave input into the design and the content of the roadmap. The content means the categorization, timing, content per group and prioritization of the

trends. The expert has also participated in this research in numerous short meetings during the research conceptualization and current state analysis data collection phase. The researcher and the expert have been discussing the technology trends and drivers related to the 3GPP standards and the impact of megatrends on the case company OCS and the case company itself. The virtualization and NFV technologies have been discussed particularly much since the case company has been progressing in the virtualization of its OCS during this research. Thus, the next required development steps and impact of new technologies have been relevant and active topics inside the case company during the whole time of this research.

5.1   The business road mapping process

The Telco industry is experiencing a disruptive era which is challenging for both the Telcos and the technology industry providing solutions and services to the Telcos. The information amount is increasing and the need to systematically scan and monitor the dynamic Telco business environment, both macro, and microenvironments, is essential to be and stay relevant and sustainably profitable in the markets. Simultaneously, the new technologies, such as 5G and IoT, that are on our doorstep are changing the way we live and work as well as our behaviour using the new technologies and services in our lives.

Enterprises require effective and feasible future planning tools and using a combination of scenario planning and forecasting clearly is an effective and awarding method. It helps the enterprises to identify the trends and requirements that have an impact on their products and services and on the enterprises themselves. The enterprises need to listen to the voices of their customers and their business environment carefully to stay aware of the expectations that they have regarding the technologies and services they use and consume.

Furthermore, it is important that the enterprises establish an internal process based on the above-mentioned forecasting and scenario methods and tools. This requires full support from the management of the company since it is consuming resources and time to be efficient. The aim of the scenario planning is to increase the capability of the enterprise to understand and visualize what kind of future alternatives they might have. It is an effective method of stop, think and go out from the comfort zone and visualize what all kinds of alternative futures one might have. This stimulates the decision makers to be aware of alternatives when they make decisions and develop strategies, impacting the

future of the company. Moreover, combining forecasting of uncertainties to scenario planning enforces the process, and the outcome is even more rich and advantageous for the managers and companies.

Once the trends and the customer requirements have been identified, a tool to quantify and prioritize the trends and customer requirements was used. These categorized drivers of change are the key forces that are summarized in a form of a customized business roadmap.

In view of this, the researcher using these above-mentioned tools, identified the trends and technologies that are relevant to the case company.

5.2 Categorization of the identified business and technology trends and customer requirements

The key business and technology trends as well as the customer requirements, identified in the conceptual framework, are all potentially impacting the case company and its OCS product. These identified trends and requirements can be divided into three groups of drivers.
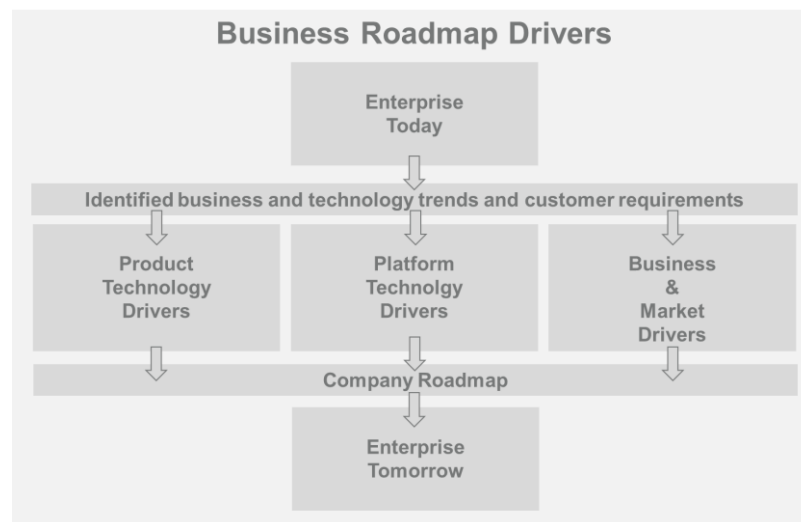

Figure 19. The business roadmap drivers

The first group is the product technology drivers, related to the case company these are mainly 3GPP requirements for the OCS, 3GPP requirements of 5G related to OCS and the essential customer specific requirements related to 4G. The 3GPP standards will impact the OCS now and in the future. The 4G related customer specific requirements

are estimated to continue several years and this is also supported by GMSA estimates that 4G technology has the largest number of connected mobile devices, 53% in 2025 and 5G only 14%. The case company has customers both in emerging and developed countries which drives the case company to be compatible with both existing 4G and new 5G related technologies.

The second group is the platform technology drivers which mainly impacts the underlying platform architecture, both software and hardware related. The trend of virtualization and NFV are actively being worked on now, so the duration of the impact is most current on these two elements. Moreover, the mega trends such as the 5G megatrend impact the OCS platform architecture, however, the impact is still not fully accurate since the 5G technology standards and possible business models and opportunities are still open. In addition, IoT is a megatrend impacting the OCS, however, the business cases of IoT are still to be defined which means the chargeable services are not yet defined. This is one of the reasons why the IoT has been prioritized as low priority however it is a multi-dimensional trend with high potential to new business to the case company. IoT has another partially overlapping impact related to the business and market drivers. IoT potentially would broaden the business environment of the case company to other industries such as utilities and further in time, potentially also to smart homes, cars and smart devices such as VR and AR devices. These are all potential elements that the Telcos or CSPs would have a requirement to control and charge in real time thus impacting the charging capability requirements of the future OCSs. In this way, they can ensure the control and monetize new future services thus being competitive and staying relevant in the markets.

In this context, additional trends included in the third group of business and market drivers are AI, MVNO/DVNO, and XaaS. AI has also been ranked as low priority since the AI related chargeable services are still not that clear and the technology use at Telco is not that common yet. The business cases are taking their form and applications for chargeable services are thus unclear. The MVNO and DVNO are related to the current and future business models of service providers. The case company OCS supports the MVNO model requirements and is required to support the new type of DVNOs in the future. This might include totally new services related to AR, VR and other new not yet known services and business models. The OCS developers should follow up these closely also since these new DVNOs might as well be new potential customer focus

group, needing a cloud-based OCS solution to control and charge the new future services. In the timeframe of few years, these type of new DVNOs most probably would require these and many other services based on XaaS model which basically would also broaden the customer base of OCS vendors in the future. The XaaS also requires a new type of multi-customer-vendor management from the vendors, Telcos and CSPs. The model is based more on selling services instead of selling application licenses to DVNOs or Telcos. The cloud-based technologies are the fundamental underlying technology that enables this type of business models and new environments to evolve.

To return to the customer-centric business models, the emphasis in all the above-mentioned trends, drivers and customer requirements should be in listening to the voice of the customer carefully. On one hand, customer experience in new technologies and devices will open up new potential business opportunities, however, the risk of losing the business to competitors increases if this voice is not heard in time. Thus, an effective ongoing evolution of customer experience development process is essential for companies to be successful in the era of new technologies. Listening and seeing the customer voice and happiness is the key to success.

5.3   Summary of the business roadmap

This chapter summarizes the key business and technology trends and drivers for change as well as the customer requirements in a form of a three-layered business roadmap. The trends are prioritized and marked with corresponding colours per priority. The roadmap has been divided into three groups: business and market, platform technology and product technology drivers. The timing and duration of each trend has been estimated in the horizontal direction on the time axis. The granularity is visually half a year and the total time span is until the end of 2021 or beginning of 2022. In cases of XaaS and the 5G and IoT megatrends as well as the reach of standards and new emerging business drivers, the time is expected to reach well over the year 2022. The priority of the three groups in different layers is a logical order. The business and markets drivers are the highest level of elements of impact to the product. The middle and lowest layers are closer to the impact to the case company OCS product. Based on the input from the case company expert, a combined trend element based business roadmap was created. This roadmap in Figure 21 visualizes the high-level business goals and suggested actions based on the combined trends. It is clarifying the business goals of each group of drivers and this goal is estimated to be reached in 2—3 years with the thought that these business goals would evolve.

Due to limitations in time in the scope of this research, these business goals and a more detailed action plan should be investigated and evaluated in a separate case company internal workshop.
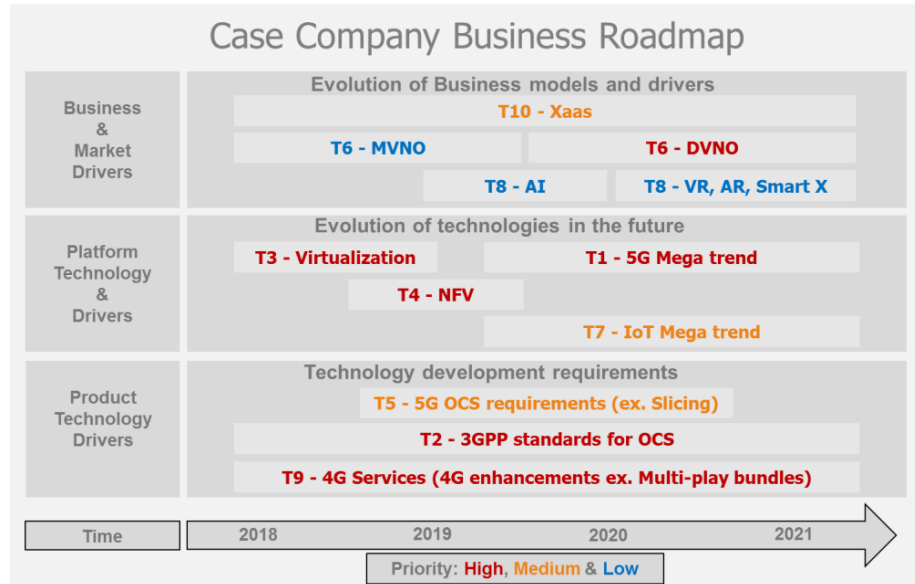

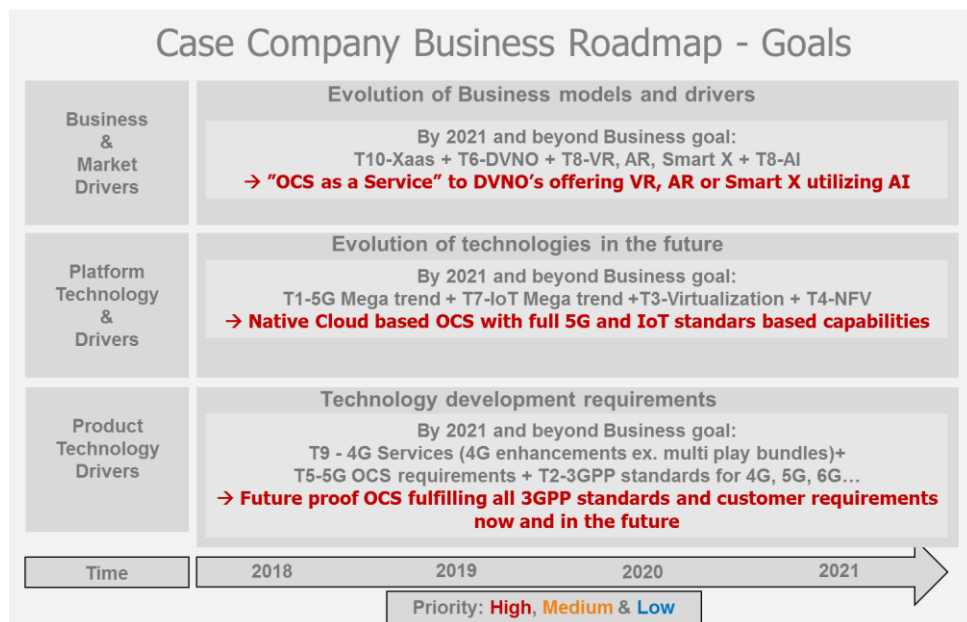Figure 20. Co-created case company business roadmap

Figure 21. Co-created case company business roadmap with business goals

In particular, it is important that the business roadmap is maintained by updating it after each, for example, half year evaluation of the status of each of the elements in the business roadmap.

In this way, the business road map stays relevant and active and the stakeholders maintain the momentum to have good visibility to the changes in the dynamic business environment and the world around us.

The business roadmap will be used in the development of the case company strategy and the cycle of checkpoint should coincide with the follow up of the company strategy.

Strategic working requires effective and visual tools and this business roadmap is improving the strategic management of the companies and as we all know, there is always space for improvement in the way how companies are managed and operated.

The business roadmap will be validated in the third context by a senior Finnish Telco executive and the feedback will be evaluated and actioned in the next chapter.

6   Feedback on the proposed business roadmap in a third context

6.1   Overview of a feedback round

This chapter will describe the validation of the case company business roadmap in a third context. The selected person is a senior business executive in a Finnish entity of a Nordic Telco Enterprise who has extensive experience from Telco industry and knowledge of the case company and its OCS product on a high level.

The executive was contacted to validate the research proposal Chapter 4 of the research including the graphical case company business roadmap in Figure 20. The Chapter 4 of this research was sent to the executive by email for comments and input. Chapter 1.2 was sent for the purpose of sharing some background with the executive to gain a better understanding of the purpose, business challenge, objective and output of the research. The background information and chapter 4 included the same graphical elicitation which was used in the case company customer interview.

The validation was completed in 2 days and the executive sent the comments to the Chapter 4 back to the researcher by email. This input is summarized and evaluated in the next subchapter.

6.2   Input received and its impact

This subchapter summarizes the input from the validation phase of this research. The details of this last data input can be found from the research data plan in chapter 2.2 Figure 7.

The researcher sent the chapters 1.2, and 4 including all subchapters to the Finnish Telco executive for validation. These chapters included also the Figure 15 and 16 which illustrate the status of the case company OCS compatibility to the cloud-based technologies. In addition, the abstract of the thesis was shared so the validator could have a broader background to what the research is about and what the output of the research is.

The feedback from the executive was that the research covered well the short-term business and technology trends. The technical part feedback was limited due to the knowledge of the executive being related more to high-level business trends than to the technical elements.

Moreover, according to the executive, one potential item that could be beneficial to evaluate further is how the invoicing or charging would evolve since in his opinion the invoicing and mobile payment area is so scattered in the Telco world and the new EU payment directive is regulating the payments. In addition, he was questioning if for example Apple, who seems to be willing to enter as a player in the mobile payment field jointly with a Finnish bank, could be a potential new customer of case company OCS type of solutions.

Technically, this idea of evaluating new Application Programming Interfaces (API) to allow access to the mobile payment-related signalling of mobile devices such as Apple or other mobile payment applications is recommended to be evaluated. This idea is related to a technology area called Mobile Payments. In case this type of transaction would require the access by the mobile user to use his or her mobile subscriber account balance to pay for a service or product at the point of sale in a store, this could be feasible. Since this requires a separate investigation and there is a limited amount of time, this will be recommended to be investigated but will not be included in the business roadmap as a separate new item.

6.3   Summary of the final business roadmap

This chapter will summarize the impact of the data from the validation phase of this research.

There were no changes to the first proposed business roadmap as one can observe in Figure 22 below.
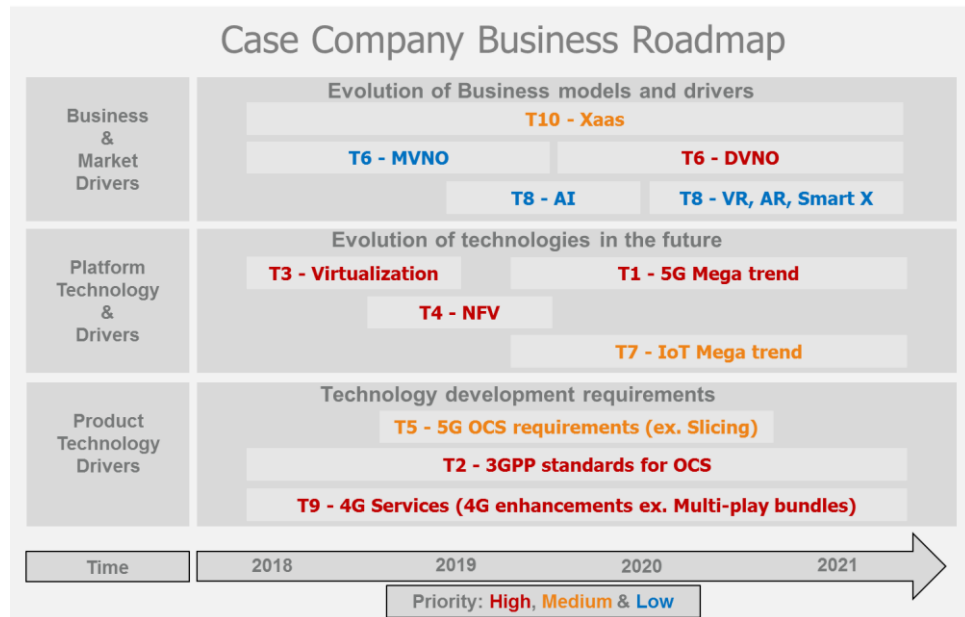

Figure 22. Final case company business roadmap

As a summary from the validation phase, the idea of Mobile payment is not included into the business roadmap as a separate new trend but it is recommended by the researcher to be further investigated and evaluated in the near future.

The final version of the case company business roadmap and the related business goals will be presented to the employees of the case company. The idea is to jointly walk through the identified business and technology trends as well as the customer requirements to enlarge the visibility of the case company employees of the future of the company. This work shop is also the time and place to give the feedback to case company employees to the initial involvement to the design of the research interviews and business development.

The researcher will also send the final version of the business road map to the case company customer interviewee and the Finnish Telco executive who validated this research. This is seen as good business practice towards the executives who have shared their valuable time and given valued input to the researcher and the case company.

As mentioned in this research, the business roadmap will also be used in developing the case company strategy jointly with the Board of Directors of the case company. In addition, the next checkpoint is the follow up of the roadmap at the latter part of 2018 in preparations of the year 2019 strategies and budgets of the case company.

As a recommendation to all who are following up various types of business and technology trendsetting white papers or publications, the trends are often "hyped" a lot in the beginning but once the real business evidence is realized, one should be sceptic about what is a feasible and reliable source of information. The researcher have observed in the last two and half years that the trends, from only a few years ago, has changed a lot and it seems that in general 5G and IoT megatrends "noise" is starting to settle. One might even say that the latest publications and news related to 5G and IoT indicate publicly that maybe the expectations of especially 5G have now been built too high in comparison to what the reality will most probably be. (Telecom TV 2018).

Generally, this research has been professionally educating and the view and vision of the researcher have sharpened to be even more objective and wide after this big exercise of evaluation of the future new technologies and business models.

Following the "future picture painting" idea from Pilkahn, here is a short researchers story of how the future could look like, in the scope of this research:

Future cloud-native OCS will be able to charge multi-industry digital services that have been created utilizing the power of AI which dynamically offers end users services based on learning automatically from the behaviour of the user's needs. The operators empowered by intelligent digital systems would dynamically monetize in real time services of new smart devices using the embedded voice and pattern recognition systems to enhance the customer's experience. Subscribing to new services to your home and work with utilizing the above mentioned digital recognition systems would be automatically provisioned into the digital systems and charging of the services would be actually made from citizens general account. Future business models are dynamic and flexible including all digital services from smart devices running on AI-based operating systems to services related to smart cars, homes, and cities. The digital communication service providers

and the technology and business service providers work in new virtual business models supported by the overarching business social digital partnering systems.

7 Discussion and Conclusions

7.1 Summary of the whole project

The original reason for this research was that the researcher was evaluating and monitoring constantly the new business and technology trends in various digital forums on the internet. The amount of information available was challenging and the researcher had difficulties to categorize and make sense of all the available information.

At the same time, the importance of the cloud-based technologies started to raise its head indicating the need to support these technologies which the case company did not yet support.

Chiefly, the researcher needed to gain knowledge of the methods and tools that could help him in his business development tasks and in the identification of relevant new business and technology trends from the big amount of information. Simultaneously the research was complemented with first-hand information from one of the key customers to gain supportive or non-supportive input to the researcher's subjective view.

The actual business challenge has been clarified quite well and the solutions including the next steps that are required are clearer. In addition, the original challenge that the case company OCS does not support cloud-based technologies is still there however there actually has been practical progress in the development path toward supporting cloud-based technologies. Furthermore, now there is a clearer view on what type of key business and technology trends and customer requirements and drivers should be monitored and acted upon which is visualized in the form of a graphical new business roadmap of the case company.

The focus during the research got clearer and instead of focusing only on the case company OCS product, broader business aspects and technologies have been included into the scope of this research.

The importance of the research is big since the case company OCS is the only product that the case company has. Thus, it is obvious that having a clearer view of the future requirements and possible scenarios gives the case company better keys to sustainable future business success.

Referring to researchers, now the case company's success depends on its ability to adapt to the required changes. With this in mind, it is essential that the case company now utilize its capability to anticipate the required changes and developments to be able to detect the business opportunities and risks involved. The case company should now consider and take actions in its business strategy to the identified opportunities fast to ensure its future success. (Pilkahn 2008).

7.2   Practical and managerial implications

The business roadmap process is an important element for the case company operations and the development of the case company's product. The case company has been developing and maintaining technology roadmaps with only some business aspect in them but now the idea is to develop further the road mapping process to include more business point of view embedded into the road maps.

The importance of the business aspect is evident. The employees often ask about the strategy and direction of the company and showing a business roadmap visualizes the future plan of the company well.

Review and next updating of the business roadmap is planned to be done in a workshop including all the employees of the company. The case company is a small software developing company and it is, therefore, feasible to involve all into the next follow up phase of the business roadmap.

In order to have even further effective business roadmap, involving the customers into the process will be considered. Co-creating roadmaps with customers and technology partners could be developed further to use this type of business roadmap as a base when arranging technology and business workshops with the key customers.

Co-evolution of business roadmaps jointly with key customers would develop the customer relationships further to another level increasing the ever so important customer experience cooperation with the case company.

The need for strategic partnering, including a co-evolution requirement, is out there and this type of business roadmap process could be included in these partnership business models.

7.3 Evaluation of the Thesis

This subchapter evaluates the success of the research comparing the outcome and the prime objective of the research project. The second subchapter describes the reflection and learning the researcher has experienced during the whole research project.

7.3.1 Outcome vs Objective

The objective of the research project is to develop a business roadmap for the case company to meet the above-discussed cloud technology challenge in the context of the company's key customer and the business and technology trends related to the charging capabilities of the company's OCS software product.

As a result of this research project, the outcome is a business roadmap including the drivers and trends relevant and feasible to the case company. The company can utilize the roadmap for its future product and business development considering the key customer and the future charging requirements of an OCS supporting the underlying cloud technologies.

The researcher sees that the business roadmap is useful however there is an indication that some of the identified trends and some additional technology trends and customer requirements should be further evaluated. The reason is that the case company has other key customers in developed countries and they would most likely broaden the customer requirements list. There are also a few requirements that are under NDA which most likely will also need to be further investigated thus were not possible to include into this research.

7.3.2   Reliability of the research project

This research has been following criteria defined by researchers: credibility, transferability, dependability and confirmability. (Shenton 2004).

Credibility is mainly based on the use of research methods according to the literature review. The use of these qualitative research methods, including the semi-structured in-depth interviews, are described in the chapter 3 of this research. Participants in this research were employees of the case company, an existing customer procurement executive and a business executive who was leading a Telco operator using the case company product.

Accordingly, the participants therefore had a good knowledge of the case company, its culture and its product. The decision of the approach of selecting only stakeholders who knew in advance the case company and its product was based on that the information collected would be as credible as possible in the scope of this research.

Triangulation was ensured by selecting as informant's experienced case company employees, one existing client's senior procurement executive in emerging markets and one business executive with experience of Telco business environment of a developed market.

During the semi-structured in-depth interview, the interviewee was asked both during and after the interview clarifying questions and probes about the technology and business requirements which iteratively confirmed the collected information. This process and related research methods and considerations are described more in detail in Chapter 3.4.2. The case company expert participating the research in numerous informal meetings shared valuable and professional information elements during a longer period of time. This process of collecting the current status of product and technology information build a solid information base to the researcher. This collated information was used as a base in the co-creative phase of this research, which described more in details in chapter 5 of this research.

Besides the informants, input, guidance and knowledge from the meetings with the supervisor and the group seminars at the university during the project were valuable part

in this research. The researcher gained knowledge of the research methodology, importance of objectivity and suppositionless and the overall approach and view was widening during these sessions.

Aforementioned on-going meetings and discussions with case company experts during the research project broadened the researcher knowledge and base for better peer scrutiny of the research and the researcher. The researcher also participated to web seminars related to technology and business trends which also were helpful in widening the view and argumentation of the researcher. Furthermore, the case company experienced experts reviewed this research document however no actionable input was given.

The researcher being an employee of the company, the subjective selection and decision point has been mentioned in the research including the reasoning of these steps. The researcher's skill of objective observation and the importance of this objectivity was developed during this research project. Also, the importance of the relevant information collection and the reliability and credibility of the information and the source of the information have been considered in this qualitative research by the researcher.

Experience of the researcher and the informants played an important role in this thesis however the more detailed qualifications and description of experience was not applied in this research.

Informants were all given an opportunity to approve and comment on the parts of the research they were involved and the interviewees confirmation of the notes of the interview were shared with the supervisor of this research. According to chapter 5, the case company expert input to the proposed business road map was actioned upon and the validation phase input was not included into the final proposed business roadmap. Instead the input from the validator was recommend by the researcher to be further investigated.

The description of phenomenon under scrutiny is covered in the chapter 1 of this research and the related earlier investigations and research methods and tools collected from the existing literature, has been described in the chapter 3 in this research.

Furthermore, related to the transferability of this research, the data collection process, the quantity of informants, the number of organizations, and data collection methods are

described more in detail in the chapter 2. Moreover, it is important to understand that the pre-research evaluation and monitoring of the business and technology trends started about one year before this research started in 2016. This was conducted by the researcher.

Dependability of a qualitative research requires a reliable and consistent process definition and design. This is to be able to conduct and copy the research method and to be able to gain similar output of the research.

The research design and the process is described in chapter 2.1 of this research and the data collection process and the implementation of it is described in 2.2. All the steps and methods in the research design and data collection plan were followed and implemented accordingly.

Confirmability in this qualitative research relates to how objective or subjective the researcher has been and that the first-hand information was truly from the informants. The parts in which there has been any level of subjectivity have been clearly stated with justification for it, in the scope of this research. The permission of researcher perception and assumptions are therefore approved however all opinions or subjective decisions have been described and grounded.

With this in mind, the description of the methodologies related to the research design, the data collection and the conceptual frame work are described in chapter 3. A supportive and illustrative method with many graphical diagrams have been created to visualize and clarify the research, the research process, identified synthesis of findings and the co-created output of this research.

Accordingly, based on the above described evaluation and on the fulfilment of most of the credibility, transferability, dependability and confirmability criteria defined by Shenton, this research can be assumed as trustful.

7.3.3 Afterword

The whole process of learning the research methodologies during the seminars at the university and the gates model has taught me a lot. The combination of the seminars, the guidance from the supervisor and the new knowledge gained through reading the

literature have been an interesting and eventually awarding journey. Also the actual writing of this thesis has improved my writing skills.

Generally, the most challenging part of the research process was the conceptualization phase of the research process however simultaneously it was clearly the most awarding part after all challenges.

The result of this research was broader than what I expected originally, however, the outcome and the new knowledge and the gained experience is clearly bigger than expected. The personality of the researcher is sometimes too enthusiastic which can time to time cause some level of over-swelling of the scope but it was kept under control successfully.

To summarize, the decision at the beginning of this thesis of not to follow Albert Einstein's words was awarding. The researcher actually is better equipped with knowledge of why it is good to think of the future, especially when doing a research on new emerging technologies and business trends. This is despite that the future will happen soon enough!

References

Amer et al. (2012). A review of scenario planning. *Futures*, 46, 23-40 www.sciencedi-rect.com [online] Available from: https://www.sciencedirect.com/sci-ence/article/pii/S0016328712001978?via%3Dihub [Accessed 3 May 2018].

Bokun et al. (2016). Analyses Mason Report in June 2016: The impact of telco cloud transformation and hybrid network management on CSPs' operations. www.sdxcentral.com [online], 3. Available from: https://www.sdxcen-tral.com/articles/featured/hpe-impact-telco-cloud/2016/09/ [Accessed 3 May 2018].

Carlson, W. (2016). NFV Market Worth Over $15B by 2020, says IHS. *SDx Central* [online] Available from: https://www.sdxcentral.com/articles/news/nfv-mar-ket-worth-over-15b-by-2020-according-to-ihs-markit-report/2016/07/ [Ac-cessed 3 May 2018].

Cision PR Newswire (2018). SDN, NFV and Network Virtualization Ecosystem Market to Grow 45% CAGR Nearly $22 Billion by 2020. *Cision PR Newswire* [online] Available from: https://www.prnewswire.com/news-releases/sdn-nfv-and-network-virtualization-ecosystem-market-to-grow-45-cagr-nearly-22-billion-by-2020--reportsnreports-668143903.html [Accessed 3 May 2018].

Columbus, L. (2018). A roundup of the internet of things forecasts and markets esti-mates 2018. *Enterprise CIO* [online] Available from: https://www.enter-prise-cio.com/news/2018/jan/04/roundup-of-internet-of-things-forecasts-and-market-estimates-2018/ [Accessed 3 May 2018].

Columbus, L. (2017). 2017 Roundup Of Internet Of Things Forecasts. *Forbes* [online] Available from: https://www.forbes.com/sites/louiscolum-bus/2017/12/10/2017-roundup-of-internet-of-things-fore-casts/#2b438fe1480e [Accessed 3 May 2018].

Columbus, L. (2018). Roundup Of Machine Learning Forecasts And Market Estimates, 2018. *Forbes* [online] Available from: https://www.forbes.com/sites/louis-columbus/2018/02/18/roundup-of-machine-learning-forecasts-and-mar-ket-estimates-2018/#7e966dc42225 [Accessed 3 May 2018].

Costello, H. (2018). Mobile Virtual Network Operator (MVNO) Market 2018-2023: Ser-vice Adoption & Market Share Analytics by Operational Model, Sub-scriber, Application and Overall Revenues. *Reuter* [online] Available from: https://www.reuters.com/brandfeatures/venture-capital/article?id=30287 [Accessed 3 May 2018].

Dehra, N. (2011). Techniques Used in Business Requirements Gathering. www.brighthub.com [online] Available from: https://www.brighthubpm.com/project-planning/60264-techniques-used-in-business-requirements-gathering/ [Accessed 3 May 2018].

Edwards et al. (2013). What is qualitative interviewing? www.bloomsburycollec-tions.com [online] 59-61 Available from: http://eprints.ncrm.ac.uk/3276/1/complete_proofs.pdf [Accessed 3 May 2018].

Elgendy, M. (2016). Business needs vs. requirements. *Mohammed Elgendy blog* [online] 2. Available from: http://mohamedelgendy.com/blog/business-needs-vs-requirements.html [Accessed 3 May 2018].

Ericsson (2018). Ericsson Mobility Report 2017. www.ericsson.com [online], 10, 12 and 17. Available from: https://www.ericsson.com/en/mobility-report/internet-of-things-forecast [Accessed 3 May 2018].

ETSI (2017). Network Functions Virtualization (NFV), Network Operator Perspectives on NFV priorities for 5G. www.portal.etsi.org [online], 2, 6. Available from: http://portal.etsi.org/NFV/NFV_White_Paper_5G.pdf [Accessed 3 May 2018].

Famous quotes 123 (2018). www.famousquotes.com [online] Available from: http://www.famousquotes123.com/albert-einstein-quotes.html (Accessed 3 May 2018].

Furrukh et al. (2003). Technology road mapping—A planning framework for evolution and revolution. *Science direct* [online] 6, 8, 10, 11-15, 17-19, 21. Available from: https://www.sciencedirect.com/science/arti-cle/pii/S0040162503000726 [Accessed 3 May 2018].

Gartner (2017). Gartner Says Worldwide Public Cloud Services Market to Grow 18 Percent in 2017. *Gartner* [online] Available from: https://www.gart-ner.com/newsroom/id/3616417) [Accessed 3 May 2018].

Gartner (2018). Global AI Business Value to Reach $1.2 Trillion in 2018. *Gartner* [online] Available from: https://www.lightreading.com/artificial-intelligence-machine-learning/gartner-global-ai-business-value-to-reach-$12-trillion-in-2018/d/d-id/742564 [Accessed 3 May 2018].

Globe Newswire (2018). Global 2G, 3G, and 4G Wireless Infrastructure Revenues to Grow at 2% CAGR between 2017 and 2020. *Report Sellers* [online] Available from: https://globenewswire.com/news-re-lease/2018/04/19/1481915/0/en/Global-2G-3G-and-4G-Wireless-Infra-structure-Revenues-to-Grow-at-2-CAGR-between-2017-and-2020.html [Accessed 3 May 2018].

Global Newswire (2018). Global 5G Markets 2020-2025 - Market is Forecast to Grow at a CAGR of Around 97%. *Global Newswire* [online] Available from: https://globenewswire.com/news-re-lease/2018/03/29/1455588/0/en/Global-5G-Markets-2020-2025-Market-is-Forecast-to-Grow-at-a-CAGR-of-Around-97.html [Accessed 3 May 2018].

Grimadlo et al. (2016) 5G Open Doors for New Disruptive Market Leaders. *Strategy Analytic* [online] Available from: https://www.strategyanalytics.com/strategy-analytics/news/strategy-analytics-press-releases/strategy-analytics-press-release/2016/07/14/5g-opens-doors-for-new-disruptive-market-leaders-says-strategy-analytic#.Wtm5qy5uayo [Accessed 3 May 2018].

GSMA (2018). The Mobile Economy 2018. www.gsma.com [online], 2, 3, and 6, Available from: https://www.gsma.com/mobileeconomy/ [Accessed 3 May 2018].

Jurgens-Kowal, T. (2011). Roadmapping 101. *Global NP Solutions* [online] 3-4. https://globalnpsolutions.com/services/npd-resources/white-papers/roadmapping-101/ [Accessed 3 May 2018].

Mack et al. (2011) Qualitative Research Methods: A data collectors guide. www.fhi360.org [online] 2, 29, 31-33. Available from: https://www.fhi360.org/sites/default/files/media/documents/Qualitative%20Research%20Methods%20-%20A%20Data%20Collector's%20Field%20Guide.pdf [Accessed 3 May 2018].

Manyika et al. (2013). Disruptive technologies: Advances that will transform life, business, and the global economy. www.mckinsey.com [online], 3-4. Available from: https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/McKinsey%20Digital/Our%20Insights/Disruptive%20technologies/MGI_Disruptive_technologies_Full_report_May2013.ashx [Accessed 3 May 2018].

MarketsandMarkets (2016). *Revenue Management Market by Solutions (Risk Management, Pricing and Revenue Forecast Management, Revenue Analytics, Revenue Leakage Detection, Channel Revenue Management) by Services (Professional, Managed) by Deployment Mode - Global Forecast to 2020. MarketsandMarkets [online] Available from:* https://www.marketsandmarkets.com/Market-Reports/revenue-management-market-264806846.html [Accessed 3 May 2018].

Marr, B. (2018). The key definitions of artificial intelligence AI that explains its importance. *Forbes* [online] Available from: https://www.forbes.com/sites/bernardmarr/2018/02/14/the-key-definitions-of-artificial-intelligence-ai-that-explain-its-importance/2/#6f5530685284 [Accessed 3 May 2018].

Master of project Academy (2018). Collect requirements process. *Master of Project academy* [online] Available from: https://blog.masterofproject.com/collect-requirements-process/ [Accessed 3 May 2018].

Mcc-Mnc (2018). Mobile Country Codes (MCC) and Mobile Network Codes (MNC). *Mcc-mnc Country networks* [online] Available from: http://www.mcc-mnc.com/ [Accessed 3 May 2018].

MEMSQL (2018). 2018 Outlook: Machine Learning and Artificial Intelligence. *MEMSQL* [online] Available from: http://blog.memsql.com/2018-outlook-machine-learning-and-artificial-intelligence/ [Accessed 3 May 2018].

Mochal, T. (2008). 10 techniques for gathering requirements. www.techrepublic.com [online] Available from: https://www.techrepublic.com/blog/10-things/10-techniques-for-gathering-requirements/ [Accessed 3 May 2018].

Nagar, S. (2015). Requirements Gathering Techniques for IT Business Analyst www.linkedin.com [online] Available from: https://www.linkedin.com/pulse/requirements-gathering-techniques-business-analyst-swadeep-nagar/ [Accessed 3 May 2018].

Pillkahn, U. (2008). Using trends and scenarios as tools for strategy development. John Wiley & Sons, 5, 86, 87, 91, 122, 123, 126, 128, 137-139.

Saffo, P. (2007). 124 Harvard Business Review: Six Rules for Accurate and effective Forecasting. www.hbr.org [online] Available from: www.hbr.org [Accessed 3 May 2018].

Scales, I. (2018). Telecom TV 2018: NFV 5 years in. www.telecomtv.com [online] Available from: http://www.telecomtvperspectives.com/series/ttv-special/nfv-5-years-in/#sect-1 [Accessed 3 May 2018].

SDx Central (2018). 2018 NFV Report Series Part 1: NFV Infrastructure (NFVI) and VIM. www.sdxcentral.com [online], 1. Available from: https://www.sdxcentral.com/reports/nfv-infrastructure-nfvi-vim-download-2018/ [Accessed 3 May 2018].

Sdx central (2018). SDx Central IoT Infrastructure report. www.sdxcentral.com [online], 1, 3, 6 and 9. Available from: https://www.sdxcentral.com/reports/2017/internet-of-things/ [Accessed 3 May 2018].

Sdx central (2018). SDx Central. ONLINE: https://www.sdxcentral.com/iot/?c_action=num_ball [Accessed 3 May 2018].

Shenton (2004). Strategies for Ensuring Trustworthiness in Qualitative Research Projects. www.researchgate.net [online] 63-75. Available from: https://www.researchgate.net/publication/228708239_Strategies_for_Ensuring_Trustworthiness_in_Qualitative_Research_Projects [Accessed 7.5.2018].

Smith, A. (2000). Business Requirements Gathering – An Overview. www.TDAN.com [online] Available from: http://tdan.com/business-requirements-gathering-an-overview/4842 [Accessed 3 May 2018].

Statista (2018). Telecommunication operators/companies worldwide by revenue in 2016 (in million euro). *Statista* [online] Available from: https://www.statista.com/statistics/221382/revenue-of-top-30-global-telecommunication-operators/ [Accessed 3 May 2018].

Steinar (1996). InterViews: An introduction to qualitative research interviewing. SAGE Publications Inc. 32-33, ISBN 0-8039-5819-6 hardcover.

Straus et al. (2004). Roadmapping for Dynamic and uncertain environments. www.citeseerx.ist.psu.edu [online] Available from: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.458.2065&rep=rep1&type=pdf [Accessed 3 May 2018].

Techterms (2018). Bot definition. *Techterms* [online] Available from:
https://techterms.com/definition/bot [Accessed 3 May 2018].

Techterms (2018). IVR definition. *Techterms* [online] Available from:
https://techterms.com/definition/ivr [Accessed 3 May 2018].

Telecom TV (2017). 5G Evolution: The road to utopia 2017. www.telecomtv.com
[online], 4. Available from: http://www.telecomtv.com/pages/5g-survey-
results/?utm_campaign=TTVPolls_070917_TTVConsumptionTim-
ing_5GroadToUtopiaSurvey&utm_medium=web&utm_source=TTVSur-
veyPage [Accessed 3 May 2018].

Ulwick, A. (2003). The Strategic Role of Customer Requirements in Innovation.
www.strategyn.com [online] 1, 2. Available from: https://strate-
gyn.com/files/Strategyn-Strategic-Role-of-Customer-Requirements.pdf
[Accessed 3 May 2018].

VMWare (2006). Virtualization. *VmWare* [online] Available from:
https://www.vmware.com/pdf/virtualization.pdf [Accessed 3 May 2018].

3GPP (2018). 3GPP TS 32.296 version 14.0.0. 3GPP [online] Available from:
http://www.3gpp.org/

3GPP (2018). 3GPP LTE TS 22.115. 3GPP [online] Available from:
http://www.3gpp.org/

3GPP   (2018).   3GPP   TS   22.261   [102].   3GPP   [online]   Available   from:
http://www.3gpp.org/